PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

WASHINGTON

VOLUME 33

PUBLISHED BY THE SOCIETY
WASHINGTON, D. C.
1931

ACTUAL DATE OF PUBLICATION OF VOLUME 33

Number 1—pages 1–28 inclusive . . . . *February 9, 1931*
Number 2—pages 29–48 inclusive . . . . *February 25, 1931*
Number 3—pages 49–67 inclusive . . . . *March 21, 1931*
Number 4—pages 69–92 inclusive . . . . *April 27, 1931*
Number 5—pages 93–124 inclusive . . . . *May 15, 1931*
Number 6—pages 125–164 inclusive . . . . *June 22, 1931*
Number 7—pages 165–188 inclusive . . . . *October 16, 1931*
Number 8—pages 189–212 inclusive . . . . *November 23, 1931*
Number 9—pages 213–238 inclusive . . . . *December 28, 1931*

Press of
H. L. & J. B. McQueen, Inc.
Washington, D. C.

TABLE OF CONTENTS OF VOLUME 33.

PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 33 JANUARY, 1931 No. 1

THE ENVIRONMENT AND BEHAVIOR OF SOME BRAZILIAN MOSQUITOES.[1]

By RAYMOND C. SHANNON.

(*From the Yellow Fever Laboratory of the International Health Division of the Rockefeller Foundation, Bahia, Brazil.*)

OUTLINE.

[1]The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of the Rockefeller Foundation.

The laboratory building was furnished by the State of Bahia, through the kindness of Dr. Barros Barreto, Secretary of Health.

INTRODUCTION.

The object of the present communication is to draw attention to certain facts relating to the environment and biology of mosquitoes, which were learned in the course of investigations on the mosquito fauna of the middle coast states of Brazil, recently conducted by the Rockefeller Foundation Yellow Fever Staff.

Part I contains a general account of the mosquito fauna of Brazil, with special reference to that of the middle coast states. The species of this region are listed together with their larval habitats, which are more fully treated in the remainder of the paper.

In Part II an attempt is made to classify the larval habitats on a natural basis, and it is shown that this classification is in accord with the natural (phylogenetic) classification of the family. Consideration is given to mosquito environment as affected by man. The habits of *Aëdes* (*Stegomyia*) *aegypti* (Linnaeus)[1] are treated in detail, and by means of this species we are able to show to some extent how the choice of larval habitat probably evolved among the mosquitoes as a whole.

PART I.

THE MOSQUITO FAUNA OF THE MIDDLE COAST STATES OF BRAZIL.

A COMPARISON OF THE FAUNAS OF DIFFERENT AMERICAN COUNTRIES.

Our investigations have been chiefly concerned with the mosquito fauna of the middle coast states of Brazil, namely, Bahia, Sergipe, Alagôas, Pernambuco, Parahyba, and Rio Grande do Norte. However, in order better to orient this fauna in relation to the known mosquito fauna of Brazil as a whole, and also to show the relation of the Brazilian fauna to the American fauna as a whole, a brief summary has been made of the number of species belonging to the different genera as found in various countries. This is presented in tabular form on page 4.

The earliest comprehensive paper prepared on the Culicidae of Brazil was published by Bourroul in 1904. Incidentally, his work was based primarily on the mosquito fauna of the section of Brazil covered by our investigations. He records twenty-six species from the state of Bahia and four additional ones from the states of Alagôas, Pernambuco, and Parahyba. All but four of these species are represented in our collection of approxi-

[1]Throughout the present paper "stegomyia" is used as the common name for *Aë.* (S.) *aegypti*, and "culex" for the common tropical house mosquito: *Culex* (*Culex*) *quinquefasciatus* Say (=fatigans, Wiedemann).

mately ninety species. The four not found by us have been reported from southern Brazil.

The subsequent studies on Brazilian Culicidae, with but few exceptions, centered about the faunas of the northern states, principally Pará, and certain of the southeastern states, namely, Minas Geraes, Rio de Janeiro, and São Paulo. It thus happens that our knowledge of the mosquitoes of Brazil has been practically limited to those of the northern and southeastern sections of the country. The real interior of the country is practically unexplored, and but three species (*Anopheles mattagrossensis*, *cuyabensis*, and *triannulatus*) are known to occur there, which have not been found in the coastal and adjacent regions.

The most recent comprehensive treatment of the mosquitoes of Brazil is that by Dyar (1928) in "Mosquitoes of the Americas," in which approximately 170 species are recorded. The locality for most of these species is listed simply as "Brazil." It can not be assumed, however, that these species are actually present even in all the better known parts of the country.

Our present classified material, consisting of a small collection from Pará and a fairly complete one from the middle coast states, contains sixteen species not recorded by Dyar. Of these, only three are new to science, although probably the majority of the, as yet, unclassified species (about fifteen, chiefly Sabethines and species of *Culex*) are new.

It has proved impossible to identify absolutely all of our Sabethine material by means of Dyar's keys and descriptions alone. Moreover, it has become evident in the course of the work, that the generic and subgeneric classification of this group is far from settled and also that many of the species are imperfectly known. It should be admitted that this has not been avoidable, owing to the rarity of most of the species, the slight differences in external structure and coloration between species, and the sometimes considerable degree of variation existing within certain species. Moreover, numerous generic and subgeneric names have been proposed, and in some cases their type species are imperfectly described. It is thus evident that the group is in need of a thorough revision, based upon extensive collections. I have therefore refrained from making any changes in the system as proposed by Dyar, and also from adopting the proposed change of Costa Lima (1930), namely, that *Wyeomyia* (*Pentamyia*) *bromeliarum* Dyar and Knab be regarded as synonymous with *Dendromyia leuteoventralis* Theobald. This would necessitate an extensive regrouping of species, which no doubt would lead to still further, and at the present time haphazard, alterations. Also, for similar reasons, I have made little attempt to classify the species of *Culex*, particularly of the subgenus *Mochlostyrax*. For final identification in this group, recourse to type material which is at present unavailable is absolutely essential.

The fact that fully 90 per cent of our material from Pará and the middle coast states, most of which also occurs in the southern coast states, has already been described, indicates that the majority of the species of the coastal region are now known to science. In this connection it might be stated that one of the outstanding features of the South American mosquito fauna is the great distribution north and south of the majority of the species, many of which occur well beyond the equator on both sides.

COMPARATIVE TABLE OF MOSQUITO FAUNAS OF VARIOUS AMERICAN COUNTRIES.[1]

	All America.	Canada and United States.	Panama	British and Dutch Guianas.	Brazil	Amazon region [2]	Middle Coast States of Brazil. [3]	South-eastern States of Brazil. [4]	Argentina.
Sabethes	14	0	3	6	8	7	1	4	2
Sabethoides	9	0	3	3	5	2	2	4	1
Limatus	3	0	2	2	2	2	2	1	1
Wyeomyia	30	3	7	7	12	3+	9+	9	4
Miamyia	14	0	5	3	2	1	0	2	1
Dendromyia	26	0	14	8	7	2	3	5	1
Menolepis	1	0	0	0	1	0	0	1	1
Isostomyia	4	0	2	1	1	0	0	1	1
Goeldia	12	0	4	2	7	3	1	6	2
Joblotia	3	0	2	1	3	2	1	2	1
Psorophora	29	11	9	5	9	5	7	9	11
Haemagogus	13	0	4	2	2	1	2	1	2
Aëdes	108	75	15	13	13	9	11	11	11
Culicella	8	8	0	0	0	0	0	0	0
Mansonia	13	2	5	4	10	9	7	7	4
Deinocerites	4	1	4	1	0	0	0	0	0
Lutzia	4	0	1	0	2	1	0	1	2
Culex	162	22	45	47	58	26+	15+	35	11+
Aedeomyia	1	0	1	1	1	1	1	1	1
Orthopodomyia	4	1	2	1	2	1	1	1	0
Megarhinus	22	2	3	4	11	5	2	7	3
Uranotaenia	15	5	8	6	7	5	6	3	5
Chagasia	3	0	1	1	1	0	1	1	1
Anopheles	47	9	12	10	25	10	14	20	10
Totals	550	137	152	128	188	95	86	130	76

[1]The records for the countries north of Brazil are compiled from Dyar (1928). The Brazilian records are from Dyar, Peryassú (1908), and our collection. The Argentine records are from Dyar, and from Shannon and Del Ponte (1928).

[2]Amazon region: States of Pará and Amazonas.

[3]Middle coast states: Bahia, Sergipe, Alagôas, Pernambuco, Parahyba, and Rio Grande do Norte.

[4]Southeastern states: Minas Geraes, Rio de Janeiro, São Paulo, Santa Catharina, Paraná and Rio Grande do Sul.

+Indicates the author has additional unclassified material which contains species as yet unrecorded for the country.

The tabulation on page 4 shows a number of facts of interest.

(1) The tribe Sabethini (*Sabethes* to *Joblotia*) contains 116 species, chiefly tropical. Only three species occur in the United States; fifteen are recorded from the subtropic regions of Argentina, chiefly from the heavily forested state of Misiones.

(2) The tribe Culicini (*Psorophora* to *Orthopodomyia*) is the largest, containing 346 species. One genus, *Culicella*, is strictly of the North Temperate Zone, as are also most of the species of Aëdes; the majority of the *Culex* are tropical. The species of *Deinocerites* occur only in the Caribbean region; three other small genera, *Haemagogus*, *Lutzia*, and *Aëdeomyia*, occur from Mexico south to Argentina; while the *Mansonia* are chiefly represented in Brazil.

(3) Two tribes, Megarhinini and Uranotaeniini, with but one genus each, are chiefly tropical.

(4) The Anophelines (*Chagasia* and *Anopheles*) are chiefly tropical.

(5) Panama, by far the smallest of the regions, has proportionally much the largest recorded fauna.

(6) All of the American genera, save *Culicella* (restricted to the north temperate zone) and *Orthopodomyia*, have representatives in Argentina, while the *Psorophora* are as numerous here as in North America.

(7) An analysis of the Brazilian fauna shows that, at least along the coastal states, the fauna varies (principally as to the number of species) according to the character of the region. It also becomes evident that the faunas of the three regions here treated have been unequally studied. The Amazon fauna, undoubtedly one of the richest in the world, appears to be proportionately the least known of those of the three sections. A recent collection made by N. C. Davis in the city of Pará during two weeks' time contains approximately forty-five species, of which thirty-three have been identified. The fact that ten of these, or 33 per cent, and probably half of the unidentified species (Sabethines and species of *Culex*) are unrepresented in our collection from the middle coast states, accumulated during the course of eighteen months, clearly indicates the Pará fauna to be much the richest. Moreover, seven of the classified species have not hitherto been reported from Brazil, and two are new to science. Probably the majority of the unidentified species have not been described.

The southeastern states, owing to heavy rainfall and varied topography, probably have a fauna more or less equal to that of Pará. More species are recorded from the former region, but this undoubtedly is due to the fact that more intensive studies have been made there.

In the middle coast states the fauna is limited by the prolonged dry periods during the warmer months of the year, while during

the rainy season (late summer and winter months) the temperature is sufficiently cool to produce a marked retarding effect on mosquito development. Consequently the different species vary in point of numbers according to season. Those *Psorophora* and species of the Aëdine subgenus (*Ochlerotatus*) which utilize the temporary ground pools formed by rains are most abundant at the beginning of the rainy season, which occurs towards the end of summer. As the weather becomes cooler they largely disappear. Species breeding in tree holes, bamboo joints, etc., are more abundant in individuals at the end of the wet season, at which time the warm weather begins. As the dry season advances they tend to disappear. The topography and plant life are also somewhat unfavorable for extensive mosquito life. Only a few species are numerous to the point of being very troublesome, and these have a comparatively short season. Stegomyia and Culex, because of their intimate association with man, are largely independent of rainfall for their propagation and therefore are an exception to the statement made regarding the seasonal abundance and the number of individuals per species.

In the coastal states of Ceará and Piauhy (intermediate between the middle states and Pará) it is to be expected that, owing to the comparatively dry climate throughout the year, the fauna is still more limited than in the middle coastal states.

List of Mosquito Species of the Middle Coast States and their Larval Habitats.

Eighty-six species are listed. The unclassified species of Sabethines and of the subgenus *Mochlostyrax* (*Culex*) would probably bring the total to 100. Names of doubtful status are indicated by an interrogation point (?). An asterisk (*) indicates the species of which the larvae have not as yet been found. In the case of the latter species the authority giving the habitat, where known, is cited.

Tribe Sabethini.

(The Sabethines.)

Genus SABETHES.

albiprivus Theobald . . . . Tree-holes?

Genus SABETHOIDES.

?*purpureus* Th. . . . . Bamboo
chloropterus (Humboldt) . . . . Tree-holes (Dyar)

Genus LIMATUS.

durhami Th. . . . . Tree-holes, bamboo, nut husks, fruit rinds, fallen leaves, artificial containers
asulleptus Th. . . . . As above

Genus WYEOMYIA.

oblita Th.	Bromeliads, rare in bamboo
bromeliarum Dyar & Knab	Bamboos, occasionally in artificial containers
tripartita Bonne-Wepster and Bonne . .	Bromeliads
pallidoventer Th.	Bromeliads (Dyar)
?*guasapata* Dyar	Bromeliads?
quasilongirostris Th.	Bromeliads
?*pilicauda* Root	Bromeliads
?*flavifacies* Edwards	Bromeliads?
incaudata Root	Bromeliads

Genus DENDROMYIA.

?*mystes* Dyar	Bromeliads
?*complosa* Dyar	Swamp aroids?
personata Bourroul	Tree-holes

Genus GOELDIA.

**trichopus* Dyar	Colocasia?

Genus JOBLOTIA.

digitata Rondani	Coconut husks, tree-holes

TRIBE CULICINI.

(The Culicines.)

Genus PSOROPHORA.

Subgenus PSOROPHORA.

cilipes (Fabr.)	Rain-pools
genumaculata Cruz.	Rain-pools
ciliata Fabr.	Rain-pools

Subgenus JANTHINOSOMA.

lutzi Th.	Rain-pools
ferox Humb	Rain-pools
varipes coq.	Rain-pools (Dyar)

Subgenus GRABHAMIA.

cingulata (Fabr.)	Woodland pools, hoof-prints, xetremely rare in artificial containers

Genus AËDES.

Subgenus OCHLEROTATUS.

fulvus Wiedemann	Rain-pools (Dyar)
serratus Th.	Grassy rain-pools
?*nubilus*	Woodland rain-pools
scapularis Rond.	Grassy rain-pools
?*hastatus* Dyar	Grassy rain-pools

Subgenus **TAENIORHYNCHUS.**

fluviatilis Lutz . . . . . . Stream-bed rock pools
taeniorhynchus Wiedemann . . . . Marshes, rock and ground pools

Subgenus **FINLAYA.**

terrens Lutz . . . . Tree-holes, bamboo
argyrothorax B. W. & B. . . . . . . Tree-holes

Subgenus **HOWARDINA.**

fulvithorax Lutz . . . . Tree-holes, bamboo

Subgenus **STEGOMYIA.**

aegypti Linnaeus . . . . Artificial and natural containers, rock pools, exceedingly rare in ground pools

Genus HAEMAGOGUS.

equinus Th. . . . . Tree-holes
?*janthinomys* Dyar . . . . Tree-holes

Genus MANSONIA.

Subgenus **MANSONIA.**

titillans Walker . . . . Pistia and floating grass ponds
**indubitans* Dyar & Shannon . . . . . . As above (?)
**humeralis* D. & K. . . . . Pistia ponds (Dyar)

Subgenus **RHYNCHOTAENIA.**

fasciolata L. Arribalzaga . . . . . . Equisetum pools
**justamansonia* Chagas . . . . Sedge or equisetum pools (?)
**chrysonotum* Peryassú . . . . As above (?)
**albicosta* Perry . . . . As above (?)

Genus CULEX.

Subgenus **CARROLLELIA.**

iridescens Lutz . . . . Artificial containers, tree-holes?

Subgenus **MOCHLOSTYRAX.**

theobaldia Lutz . . . . Permanent ground pools

Subgenus **MELANOCONION.**

conservator D. & K. . . . . Tree-holes

Subgenus **MICROCULEX.**

pleuristriatus Th. . . . . Bromeliads
gairus Root . . . . Bromeliads
inimitabilis D. & K. . . . . Bromeliads
imitator Th. . . . . Bromeliads
albipes Lutz . . . . Bromeliads

Subgenus **CULEX.**

quinquefasciatus Say	Artificial containers, tree-holes, ground pools (usually foul)
corniger Th.	Ground pools, stream-bed rock pools, tree-holes, bamboo, barrels, etc.
nigripalpis Th.	Ground pools
mollis D. & K.	Tree-holes
declarator D. & K.	Ground pools, frequently foul; artificial containers
coronator D. & K.	Ground pools
surinamensis Dyar	Stream-bed rock pools

Genus **AËDEOMYIA.**

squamipennis, L. A.	Vegetated, more or less permanent pools

Genus **ORTHOPODOMYIA.**

fascipes Coquillet	Tree-holes

TRIBE MEGARHININI.

(Megarhines.)

Genus **MEGARHINUS.**

trinidadensis D. & K.	Tree-holes, occasionally bamboo and artificial containers
violaceus Wd.	Bromeliads, occasionally bamboo

TRIBE URANOTAENIINI.

(Uranotaenines.)

Genus **URANOTAENIA.**

geometrica Th.	Ground and rock pools containing algae
lowii Th.	Marshes, permanent and temporary ground pools, hoof-prints, crab-holes
calosomata D. & K.	Ground pools, occasionally artificial containers
leucoptera Th.	Ground pools
pulcherrima L. A.	Ground pools
nataliae L. A.	Ground pools (Dyar)

TRIBE ANOPHELINI.

(Anophelines.)

Genus **CHAGASIA.**

fajardoi Lutz	Upland streams, chiefly in forested regions

Genus ANOPHELES.

Subgenus STETHOMYIA.

?*nimbus* Th.	Woodland pools and streams

Subgenus ANOPHOLES.

Group ARRIBALZAGA.

peryassui D. & K.	Woodland pools and streams
minor Costa Lima	Rocky streams, rarely ground pools
intermedius Peryassú	Woodland pools and marshes
mediopunctatus	Woodland pools

Subgenus KERTESZIA.

cruzii D. & K.	Bromeliads

Subgenus NYSSORHYNCHUS.

parvus Chagas	Upland, sunlit pools and streams (Root)
argyritarsis R. D.	Sunlit streams, ground and rock pools, marshes, hoof-prints, artificial containers
albitarsis L. A.	Sides of sunlit streams, ponds, ground pools
darlingi Root	Sides of sunlit streams, ponds, ground pools (Root)
bachmanni Petrocchi	Sunlit vegetated ground pools and marshes
tarsimaculatus Goeldi	Sunlit marshes, ground pools, ditches, etc.
strodei Root	Sunlit marshes, edges of streams

Subgenus MYZOMYIA.

gambiae Giles	Sunlit, over-flowed grassy fields. In Africa, also recorded from swamps, temporary pools, drains, wells, ditches, weedy streams, crab-holes, roof gutters, tree-holes, brackish pools, bilge water, water tanks, etc.

PART II.

ENVIRONMENT AND BEHAVIOR.

GENERAL CONSIDERATIONS OF MOSQUITO ENVIRONMENT UNDER NATURAL CONDITIONS AND AS AFFECTED BY MAN.

Environment, as related to mosquito life as a whole, is a highly confusing complex, owing to (1) the aquatic life of the larva and the aerial life of the adult, (2) the influence of man and his environment, (3) the large variety of species, and (4) the

great adaptability of certain species, both in the larval and adult stages.

Accurate knowledge relating to the environment of mosquito larvae dates from the time of Hooke, Swammerdam, and others, who published their observations on *Culex pipiens* in the Seventeenth Century. In 1738, Réamur published an extended account of the life history and structure of *Culex pipiens*. His observations "were so full, and his authority was accepted as so all-satisfying, that the publication of this memoir practically put a stop, for a hundred and fifty years, to further studies of the aspects of mosquito life." The only noteworthy additions were made by Joblot, who described the larva of *Anopheles* in 1754, and DeGeer, who recorded the occurrence of *Aëdes* larvae in snow-water ground pools (*vide* Howard, Dyar, and Knab, 1912). Since 1900, intensive studies have been made on the group as a whole. Increase in knowledge of mosquito biology was so rapid that, by 1912, Howard, Dyar, and Knab were able to state in their monograph on mosquitoes: "Each species, and even groups of species, has its own very definite larval habitat."

The purpose of the present article is to show that this statement of Howard, Dyar, and Knab's in reality consists of a fundamental principle in mosquito biology, namely: *The larvae of each species are more or less restricted to a special type of habitat; and further, the natural classification of the habitats is in accord with the natural classifications of the family as based on larval and adult characters.* Even in association with man's environment, the essential elements of this principle are maintained.

The presence of man, however, especially on a large scale, alters the normal environment and, to a varying extent, the mode of life of the mosquitoes. It will be useful, therefore, to treat the environment of mosquitoes from two different viewpoints, each giving a different alignment of species, both of which yield results of value:

(A) From the standpoint of the biology of mosquitoes (a natural classification).

(B) From the standpoint of the relation of mosquitoes to man (giving a highly artificial grouping of species).

(A) Mosquito Environment from the Standpoint of the Biology of Mosquitoes.

The allotment of the various species to the three classes under "(B) Mosquito Environment as Influenced by Man," is largely dependent upon the location of the preferred type of larval habitats. The present discussion will therefore serve as an introduction to the following section.

The need of water for the larval and pupal stages is universal for all species of Culicidae and accordingly is regarded as a

family characteristic. Secondary requirements are that the body of water be of comparatively small size and more or less in a state of rest. The larvae are never found in large bodies having free wave action (unless there is the shelter of floating plants, etc.) or in those having a swift, evenly distributed current. They may, however, be found along the shallow, plant-grown shores of quiet lakes and large ponds.

With regard to the tribes, genera, subgenera, and species, the location and condition of the water appear to be the primary factors which lead to the choice of habitat. The location, manifestly, is of greater importance for the majority of species; while condition appears to be of first importance only in the case of a few species of the subgenus *Culex*.

Larval habitats may therefore be classified according to (I) location, and (II) condition.

I. *Classification of larval habitats based on location.*

A. In depressions in the ground.
   1. Natural: lakes, ponds, streams, marshes (tidal and fresh), springs, rock pools, etc.
   2. Artificial: resevoirs, ditches, wells, excavations (e.g. borrow pits), road ruts, etc.

A minor class produced by animals, may be noted, e.g., hoof-prints, crab-holes, wallows, etc. The importance of these from the standpoint of mosquito biology is indicated by the fact that one genus, *Deinocerites*, and several species of *Culex* breed exclusively in crab-holes.

B. In containers on or above ground.
   1. Natural: water-holding plants (tree-holes, bromeliads, etc.), fallen leaves and nuts, etc.
   2. Artificial: Tanks, barrels, tins, bottles, unused boats, etc.

A minor class, consisting of animal remains, may also be noted: Egg-shells and sea-shells, skulls and horns of cattle, etc. An accumulation of these is at times an important source of stegomyia production.

Although it would appear from the foregoing classification that there are sharp distinctions between the four main groups of habitats, in the final analysis such do not exist. Numerous types of man-made containers, especially when abandoned in natural surroundings, partake of the characteristics of the natural ones; also artificial conditions may be imposed upon natural ones or vice versa. The interrelations of the two may be so complete at times that even the mosquitoes are unable to decide correctly. This should be taken into consideration when there are apparent discrepancies in the source of mosquito larvae. Nevertheless, the distinctions made are essentially real, as

shown by the great consistency on the part of the mosquitoes under natural conditions, and especially by stegomyiae under artificial conditions (see following section). The most notable exception to the system is furnished by the common house culex which utilizes indiscriminately both the container and the ground deposits of water. But this appears to be an exception which helps prove the rule. Its choice of habitat appears to be more influenced by the condition of the water (foul water is preferred) than by location.

An examination of the list of habitats given with the list of species (part I) shows that certain natural groups of species are addicted to the natural and artificial containers, while other equally natural groups utilize the ground collections of water. Furthermore, the records given by Dyar (1928) for the mosquitoes of all the Americas, show that this system is applicable to the entire mosquito fauna of the New World.

A brief summary, based on the records given by Dyar (1928) and supplemented by our observations, is presented to show this essential relation existing between mosquito and larval habitat.

Species occurring in ground water.

Natural and artifical deposits.

Most probably ground collections of water were the original, or primitive, habitats of mosquito larvae, and the great majority of the species belonging to the tribes Culicini, Anophelini, and Uranotaeniini still retain this type of habitat. The exceptions are given below. Providing the artificial ground collections approximate natural conditions sufficiently, the ground-water species utilize them about as freely as the natural collections.

Species occurring in natural containers.

Two entire tribes, the Sabethini and Megarhinini, are restricted to the container type of habitat. We have but one record, and that a doubtful one, of a species of Sabethine occurring in ground pools, namely *Wyeomyia oblita* (Parahyba, Brazil).

The species belonging to the Culicine and Anopheline tribes which are habituated to natural containers consist of several small, natural groups of species (subgenera or genera containing but a few species), some of which are phylogenetically widely separated from each other. These are the genera *Orthopodomyia* and *Haemagogus;* the *Aëdine* subgenera *Conopstegus*, *Finlaya*, and *Howardina;* two subgenera of *Culex: Carrollelia* and *Microculex;* and the Anopheline subgenus *Kerteszia*. In addition, certain species of the *Culex* subgenera *Melanoconion* and *Culex* are consistent breeders in natural containers; while several

other species of the subgenus *Culex*, notably *quinquefasciatus* and *corniger*, are sometimes found in tree-holes, especially those containing decaying fruits, etc.

Larvae of *Uranotaenia pulcherrima* have been recorded by Dyar as occurring in bromeliads (Panama), but as this species is usually found in ground pools (in common with its congeners) this probably constitutes an accidental occurrence.

Species occurring in artificial containers.

Only the two domestic species, stegomyia and culex, breed more or less habitually in artificial receptacles. The former no doubt originated from a tree-hole-breeding group, and it still utilizes the natural containers to some extent. The other species sometimes found in artificial containers may be regarded as facultative in this respect, and are the ones treated under section (B), class III. Those occurring with the greatest frequency are: *Limatus durhami* (Sabethine), *Aëdes taeniorhynchus* and *Culex corniger* (Culicines); and *Anopheles argyritarsis*. *Anopheles gambiae* is known to utilize artificial containers with great frequency in Africa, its native home.

II. *Classification of habitats based on condition.*

Factors which affect the condition of water.

The condition of water is dependent upon both physical and chemical factors and upon the presence or absence of plant or animal life. Some of the factors which may be noted are size; temperature; whether flowing or stagnant, shaded or sunlit, fresh or foul; presence or absence of salt or other inorganic compounds and dissolved gases; whether with or without plant life; presence or absence of enemies.

Owing to the great variety and variability of the chemical, physical and biological factors which may be present in the larval habitats, it is impossible to devise a simple and satisfactory classification of larval habitats based on the condition of the water. However, certain states of condition are obvious and these evidently are of significance for certain species. As a general rule, stegomyia larvae prefer fairly clean water, while culex larvae prefer foul water; the Anophelines of the subgenera *Nyssorhynchus* and *Myzomyia* prefer sunlit bodies of water, while those of *Arribalzagia* and *Stethomyia* are usually found in shaded pools.

B. MOSQUITO ENVIRONMENT AS INFLUENCED BY MAN.

The influence of man on mosquito life may be classified, according to degree, as dominant, partial, and non-existent. Three classes of environment corresponding to the three types

of influence, may be recognized: human (urban), intermediate (suburban), and natural (sylvan); and, according to the degree of adaptability of the different species, they may be placed rather consistently in one or another of the three classes: Class 1 contains only the two essentially domestic species, stegomyia and culex. These have become so thoroughly adapted to the human environment that they may be considered almost as obligate parasites of man. The second class contains a number of less adaptable species, which can readily exist, however, under suburban conditions both in the larval and adult stages (the facultative suburban breeders), while those of the third or strictly sylvan class are so completely unadaptable that as man encroaches upon their territory they rapidly disappear.

Class I. The essentially domestic (urban) species.

But two species, namely, stegomyia and culex, occurring in Brazil, appear to be primarily dependent upon an environment afforded by man wherein usually the entire life cycle is passed.

The habitats of stegomyia larvae.

Aëdes (*Stegomyia*) *aegypti*, the sole representative of the Old World subgenus *Stegomyia* and itself likewise of Old World origin, has, despite its rather complete domestication, maintained its ancestral behavior to a high degree. In fact, by means of this species we are able to show to some extent how the choice between the container and the ground types of larval habitats probably evolved among the mosquitoes as a whole.

Undoubtedly the original larval habitat (which is still utilized by the other species of the subgenus *Stegomyia* and allied subgenera and also to some extent by stegomyia itself) consisted of rot holes in tree trunks and other natural containers. However, the stegomyia is now so thoroughly adapted to domestic conditions, both in the larval and adult stages, that, of all insects requiring an aquatic environment in the larval state, it is the easiest to breed under laboratory conditions.

An investigation made in the city of São Salvador (Shannon, 1930) on stegomyia breeding in natural and abandoned artificial containers in the vacant lands, strongly indicated that even under seminatural conditions the species prefer artificial containers to natural ones. During the same period of time and in the same general region, an average of 26 larvae were found in the water-containing artificial receptacles, as compared with an average of 0.64 larvae in bamboos, one of their favorite natural habitats. It might be thought that if stegomyia breeding were controlled in artificial containers, the species might gradually eliminate itself from the natural ones. How-

ever, in spite of the intensive antistegomyia campaign going on throughout the city, although the number of larvae in the bamboos was greatly reduced, a certain amount of breeding persisted in these plants, thereby showing that the ancestral instinct of the stegomyia to oviposit in natural containers is sufficiently strong to give the natural containers a certain degree of significance.

The decided preference which stegomyia exhibit for the container type of habitat has been widely known since the time of Gorgas' antistegomyia campaign in Havana, Cuba. Any exceptions to this rule are worthy of special notice. Carter (1924), during his long association with the yellow fever campaigns in Central America and Peru, became so impressed by the general absence of stegomyia larvae in natural or earth-lined ground pools, that he expounded the following formula: We have not found this mosquito in nature breeding completely, that is from oviposition to imago, in any collection of water, where, at the water's edge, there was nothing but mud. Later, in view of the claim that stegomyia larvae were found breeding in great abundance in mud puddles, etc., in Africa, he modified his statement (ibid.) thus: "In the Americas we have not found, etc." It may be seriously doubted whether the African observations are correct as to the identity of the species. The only observations similar to this, to be reported from Africa in recent years, are those made by Dunn (1928) and by Riqueau (1929), both of whom found stegomyia larvae in crab-holes.

As far as the writer is aware, there is in America no clear-cut exception to Carter's formula; and it may be added, it is extremely rare to find stegomyia larvae in natural deposits of ground water of any type. They do, however, utilize cement and brick-lined excavations in the ground (cisterns, wells, etc.), even when the water-level is well below the ground surface. We have but two records of the occurrence of stegomyia larvae in natural ground deposits. On one occasion, Doyle, while at Parahyba, found larvae and pupae in a small straight and clean-sided hole that had been formed in clay soil by a temporary stream of water coming down an adjoining hillside. On several occasions in Bahia we have found larvae in rock pools, but it may be noted that rock pools are only a step removed from cement-lined cisterns. However, larvae of *Aëdes* (*Ochlerotatus*) *scapularis* and *Aë.* (*Taeniorhynchus*) *taeniorhynchus* were likewise present, and it is an extremely rare exception for stegomyia larvae to be found associated with typical ground-pool species of *Aëdes*.

Carter does not offer any explanation as to why stegomyia does not breed in mud-lined pools. We have found that laboratory-bred mosquitoes oviposit as freely on wet mud as they do on damp filter paper or on the surface of water. Under certain conditions, which are noted below, the larvae will develop and

pupate in mud puddles. However, the explanation probably can be based on the retention of the ancestral instinct of the females, which causes them to continue to choose the container-type of habitat to the practical exclusion of ground deposits.

Furthermore, an analysis of the behavior of stegomyia larvae in relation to their environment apparently affords an indication as to how the difference between the choice of the container and the ground type of habitat arose among the mosquitoes.

The behavior of stegomyia larvae.

The behavior of stegomyia larvae is very characteristic, and it is so well marked that they may be distinguished at sight from all other Brazilian species of Culicidae by their movements alone, save for one known exception, *Aëdes fulvithorax*, a sylvan tree-hole-breeding species. Their behavior is based on two factors: (1) their extreme sensitiveness to vibration and light (being strongly negatively phototropic) and (2) their method of seeking food. In addition, they are extremely restless, nearly always on the move, even when undisturbed and in moderate light. Their motions, epecially when they are disturbed, consist of intense looping movements which result in but little actual progression. Another important fact is that upon coming in contact with the bottom of the container after being disturbed, they do not remain there quietly for more than a few seconds, and it requires a long time for them to work their way gradually to the surface. In their search for food, they roam throughout the container, feeding from the surface, the sides, the bottom, and on the particles of food suspended in the water.

In contrast to their behavior the other Culicines and the Anophelines, under quiet conditions, evince but comparatively little phototropism, and when disturbed their movements have a distinctly less looping motion, and progress is rapid. *Anopheles* and *Culex* are strongly disinclined to descend to the bottom; but when sufficiently disturbed they will do so, and upon reaching the bottom they usually remain there motionless until the disturbance has ceased. Their return to the surface is usually very rapid. The Anophelines remain quiet for long periods of time at the surface of the water, and are surface feeders. All the species of *Culex* hang suspended from the water surface and feed upon the suspended food material. Most of the Aëdines (sens. lat.) are mainly bottom feeders. The Sabethines are extremely sluggish in behavior, distinctly more so than stegomyia. They remain for long periods of time on the bottom or against the sides of the container, usually ventral side up or out, and feed from the sides and bottom and on suspended food particles. Only when there is a scarcity of food will they roam about freely in the container. At such times the larvae slowly

skim along just under the water surface, ventral side up, searching for food.

Susceptibility to predacious enemies.

The restless roaming of stegomyia larvae throughout all parts of the container, especially when food is scarce, combined with their slow movements, render them easy victims of predators if these chance to be present. In our experiments made to test the susceptibility of various species of mosquitoes as prey, we have placed numbers of larvae of *Wyeomyia bromeliarum* (*Sabethine*), *Stegomyia*, *Culex quinquefasciatus*, *Aedes scapularis*, and *Anopheles argyritarsis* in jars, each containing different species of insect predators, namely, Belostomatids, Corixids, dragon-fly nymphs, and various types of predacious Culicid larvae, *Corethrella*, *Megarhinus trinidadensis*, and *M. violaceus*. Invariably, the stegomyia larvae were the first to disappear completely, and they were, in time, followed by the Sabethine larvae.

Compared with the ground collections of water, the natural containers have very few predators; while for the artificial containers we have very few records: two records of *Chaoborus*(?) *brasilensis* (subfamily Chaobarinae, Culicidae) in barrels; a few of *Corixa* sp. (Hemiptera) in large cement tanks; and two records of *Megarhinus trinidadensis* in earthenware jars in woodlands. In natural containers we find *Corethrella* spp. (tree-holes and bromeliads); *Megarhinus trinidadensis* (tree-holes); *M. violaceus* (bromeliads); *Sabethoides purpureus* (in bamboos); and a species of Tipulid, *Sigmatomera* sp. (in tree-holes).

In the ground collections, in addition to numerous insect predators, there may also occur various species of larvivorous fish.

Certain other experiments indicate very clearly that at least one reason why we do not normally find stegomyia larvae in ground pools is because if the eggs of this mosquito should be deposited in such collections the resultant larvae would not long survive, providing predators were present.

Experiment No. 1.—Two artificial mud-lined pools were made and stegomyia eggs were immediately added. The larvae completed development.

Experiment 2.—The pools were then allowed to stand until they had assumed a natural aspect by becoming more or less overgrown with vegetation. Meanwhile dragon-flies, *Culex quinquefasciatus*, and *Anopheles argyritarsis* adopted them as habitats. During the course of the five tests, over 1,000 stegomyia eggs were placed in the pools, 100 to a pool each time. Five days after each placement of the eggs, at which time the

stegomyia larvae should have been full grown, the pools were thoroughly searched, but although we obtained numerous *culex*, *anopheline*, and occasionally *Aëdes scapularis* larvae, there were no stegomyia larvae to be found.

Experiment No. 3.—Some of the dragon-fly nymphs were placed in a jar with numerous culex and stegomyia larvae. The first lot of stegomyia larva disappeared overnight, and subsequent lots disappeared with equal rapidity; the culex larvae, meanwhile, appeared to be undiminished in numbers. Finally, when no more stegomyia larva were added, the culex gradually disappeared.

Considering the behavior of the three organisms, the explanation is obvious. The dragon-fly nymphs remain at the bottom and, as they are able in clear water to detect full-grown larvae at a distance more than equal to their own length, they rapidly make away with the restless stegomyia; while the culex, being at the surface, remain unmolested. When the dragon-fly nymphs are sufficiently driven by hunger, they come to the surface and feed on the larvae located there.

Experiment No. 4.—One of the pools was then freed of enemies by the use of iodine (highly insecticidal, but very transient in nature) and more stegomyia eggs were added. These passed through a normal development.

Similar observations have been reported by Gordon (1922) from Manáos, Brazil. He noted that stegomyia larvae were not to be found in ground pools and attempted to learn whether this was due to the water's being of such character as to prevent the females from ovipositing, or whether, if oviposition did occur, the larvae would develop. Using ground-pool water, he found that oviposition occurred as readily as in the domestic waters; and providing enemies were not present, the larvae developed normally. With enemies present, the larvae disappeared in the course of 24 hours, but culex larvae persisted for 8 days under the same conditions.

We may conclude from the foregoing that one of the main reasons for the choice by the stegomyia of the container type of habitat is that, because of their peculiar susceptibility as prey, they are forced to choose habitats which are relatively free of predators. Possibly their instincts guide them still further, leading them to choose artificial containers, which are practically free of enemies. It may be noted that the number of stegomyia larvae found in natural containers is more or less inversely proportional to the number of predators present. This observation is based on hundreds of collections made from these sources in the vicinity of São Salvador. Bamboos, which have the fewest predators, have had the highest number of stegomyia larvae; tree-holes rank second, while the bromeliads, favorite haunts of *Megarhinus violaceus*, rarely contain stegomyia larvae.

The environment of stegomyia in relation to that of man.

In the city of São Salvador (Bahia), 80 per cent of the stegomyia larvae collected from the "bamboo traps" were obtained from bamboos located within 25 meters of houses; approximately 20 per cent were found between 25 and 100 meters of houses; while beyond this distance they were extremely rare. The tree-hole collections show that 85 per cent occurred in trees within 40 meters of houses, 13 per cent in those between 40 and 80 meters of houses, and less than 2 per cent in those between 80 and 160 meters of houses. It is of considerable interest to note, however, that on a few occasions adult stegomyia have been found in wooded areas within from 200 to 500 meters of houses, and also that in a series of investigations on this species in Africa, Dunn (1928) found that at 500 yards from houses the larvae were more abundant in his bamboo traps than at shorter distances.

However, the following experiments tend to show that stegomyia will not propagate under truly natural conditions in woodlands which are well isolated from houses. An approximate total of 3,000 eggs, full-grown larvae, and pupae were placed in bamboo joints, tree-holes, tin cans, and small earthenware jars in wooded areas 3 kilometers distant from houses. Only on two of the weekly inspections made during the four months following the "plantings" were there second-brood larvae in the containers, and these were found on the first and second weeks following one of the plantings. The adults always disappeared from the localities in the course of two weeks' time.

Under normal conditions, stegomyiae probably rarely fly far from their places of birth. Flight experiments made on this species show that they fly from house to house to some extent, as specimens were recovered in many different houses, sometimes at a distance of 300 meters from the one of release. Also they are able to fly for at least a kilometer over open water, as was shown by the recovery of specimens which had been released on a boat (Shannon and Davis, 1930).

Similar detailed observations have not been made on *Culex quinquefasciatus*. Its larvae are usually found in foul water, both in containers and in ground collections. They are sometimes found in fresh water deposits, in which stegomyia larvae also occur. In Brazil they are rarely found associated with wild species habituated to the plant-grown ground pools of fresh water.

The fact that stegomyia and culex are never found in unbroken virgin territory indicates that they are unable to exist without some more or less direct influence of man. Probably a better criterion for showing that these species are essentially domestic is that they are the only ones which can habitually

reproduce indoors and are the only species to be found with regularity in the centers of large cities, far removed from any more or less natural larval habitats. In fact, in uncontrolled towns stegomyia, at least, may occur far more abundantly in the more densely populated sections than in the outskirts.

Among other species, notably certain Anophelines, it is apparent that the adults deliberately seek the habitations of man, and to this extent may be regarded as domestic species. However, their occurrence in the central parts of large cities is extremely rare and probably entirely accidental, while their larvae are never found indoors, except when accidentally conveyed there from the outside water-supplies. This is true even in the case of the recently introduced African species, *Anopheles gambiae*, probably the most domestic of all Anophelines; for although its larvae have been found outdoors in all manner of domestic receptacles as well as in natural collections of water, they do not normally occur indoors. No doubt this is due to the fact that they do not thrive in completely shaded situations. Various other species are known to utilize artificial containers to some extent as larval habitats, but these are treated under Class II, the "facultative suburban breeders."

Finally, it is of interest to note that the four species of mosquito most intimately associated with man, *Aëdes* (*Stegomyia*) *aegypti*, *Anopheles* (*Myzomyia*) *gambiae*, *Culex* (*Culex*) *quinquefasciatus*, and *C.* (*Culex*) *pipians* (the latter found in temperate latitudes), are all transmitters of disease and are cosmopolitan in distribution, and that the first two species, and presumably both species of *Culex* as well, are of Old World origin. This indicates a high degree of adaptability and long association with man.

Class II. The facultative suburban species.

In all the cities in the particular Brazilian states wherein our investigations have been made, there are to be found areas which still possess some of the original natural conditions, such as woodlands, valleys, marshes, ponds, ground depressions wherein temporary rain pools are formed, and streams. Usually these, as well as the ditches, reservoirs, etc., are in a favorable state for mosquito production. We find a rather large group of species which thrive under these seminatural conditions as well as they would under strictly sylvan conditions; possibly in some cases they thrive better. These species may be termed the "facultative suburban breeders." As a rule, they seldom penetrate beyond the suburban areas, as only rarely are they found, even in the adult stage, in the center of large cities.

This group contains a large number of strictly harmless species; the most important of the obnoxious ones, some of

which have been shown capable of transmitting yellow fever under laboratory conditions; and the malaria vectors.

The following are the species most frequently observed. An asterisk (*) indicates that the species sometimes enter houses to feed; but as they rarely remain indoors during the day, they are considered only as transient visitors. *Limatus durhami*, *Wyeomyia oblita*, *W. bromeliarum*, *W. tripartita*, **Aëdes scapularis*, *Aë. fluviatilis*, **Aë. taeniorhynchus*, **Mansonia titillans*, **M. justamansonia*, **M. fasciolata*, *M. chrysonotum*, *Culex corniger*, *C. nigripalpis*, *C. declarator*, *C.* (*Mochlostyrax*) spp., *C.* (*Microculex*) spp., *Megarhinus trinidadensis*, *M. violaceus*, *Uranotaenia geometrica*, *U. lowii*, *U. pulcherrima*, **Anopheles albitarsis*, **An. argyritarsis*, **An. darlingi*, **An. bachmanni*, **An. tarsimaculatus*, **An. gambiae*.

Although all the species of this group are, or can be, quite independent of man for their existence, a number of them, especially certain Anophelines, have become more or less domesticated, particularly in the adult stage. It is highly improbable, however, that any of these species will remain indoors more than 24 to 48 hours at a time. More extensive investigations are needed to really prove this point. Cesar Pinto (1930) records that in Rincão, São Paulo, *Anopheles argyritarsis* and *albitarsis*, while common in houses at night, are rarely found there during the day. Davis (1926) has shown that in the state of Rio de Janeiro, only 3.1 per cent of the Anophelines resting in certain houses on a given day during warm weather are to be found there the following day; also it is apparent, according to his observations on *Anopheles gambiae* in Natal, that comparatively few adults of this species remain indoors during the day.

Aëdes taeniorhynchus and *scapularis* and several species of *Mansonia* are at times the cause of considerable annoyance about houses in suburban and rural districts. They enter houses with some frequency, and occasionally they remain throughout the following day.

Generally, the adults of these species remain more or less in the immediate vicinity of the larval habitats, but this depends largely upon their powers of flight and the proximity of food. *Aëdes taeniorhynchus* and *Mansonia titillans* sometimes fly from ten to thirty kilometers. Le Prince (1912) and later Zetek (1915), working in Panama during the construction days of the Canal, demonstrated that every evening there was a flight of *Anopheles tarsimaculatus* (an extremely abundant species in the Canal Zone at that time) from their larval habitats to the towns, in some instances two kilometers distant. The following morning there would be a return flight. Observations made on other species of Anophelines in other countries show that at

least some species of this genus have a flight range of eight kilometers.

However, it is extremely rare to find mosquitoes other than the essentially domestic stegomyia and culex in houses in the center of large cities. *A. taeniorhynchus* and *M. titillans* may be exceptions to this rule, and on one occasion Dr. Frobisher captured a female *Mansonia justamansonia* in the Hotel Nova Cintra in the center of the city of São Salvador, a site obviously far removed from any breeding source.

Class III. The essentially sylvan species

A large number of species, especially the so-called "rare species," owing to the peculiarity of their larval habitats and the short flight range of the adults, are never found in the immediate vicinity of dwellings, save on occasions when new land is being opened up to settlement. Others (e. g. certain tree-hole and bromeliad species) have been found only under strictly natural conditions, even though the suburban sections of a city may closely approximate natural surroundings. Thus, in São Salvador, although hundreds of collections have been made from tree-holes in more or less natural areas rather well removed from houses, no specimens of *Aëdes fulvithorax*, *Aëdes terrens*, or *Culex mollis* have yet been obtained; while in woodlands, some miles distant from the city, these species have frequently been found. Conversely, we have collected hundreds of larvae of a certain species of tree-hole-breeding *Culex*, *C.* (*Melanonoconion*) *conservator* (an innocuous species) from the suburban tree-holes, but up to the present we have not found them in unbroken woodlands.

Most of the species belonging to Class III disappear upon the development of a human environment. Owing to their limited and usually haphazard contact with man, they are all probably entirely innocuous. In their native haunts many of the species will readily attack man, but they apparently never deliberately enter houses for the purpose of obtaining food. Their occasional presence there may be regarded as purely accidental and probably due to their having been attracted by light, or having entered accidentally during flight.

NOTES ON THE FOOD HABITS OF ADULT MOSQUITOES.

Probably all mosquitoes, save those of the genus *Megarhinus*, feed to a greater or less extent on blood. It is believed, on the basis of a very few observations, that a large number of Sabethines and certain species of the genus *Culex* feed primarily on cold-blooded animals (frogs, lizards, etc.), but possibly even the majority of these will attack warm-booded animals if given

a perfect opportunity. We have collected specimens of all the species of Sabethines recorded in the list (part I) while they were in the act of attacking man.

Stegomyia apparently has a decided preference for human blood. However, under laboratory conditions, Stegomyia two weeks old, previously unfed on blood, will freely attack toads, geckos, and snakes.

The Uranotaeniini apparently have very little predilection for blood, at least for mammalian blood. We have never observed species of this tribe feeding, and only on one occasion have we found a female engorged with blood (*U. lowii*).

Time of Activity of the Adults.

Practically all of the container-breeding species of mosquitoes: the *Sabethines*, *Megarhines*, *Haemagogus*, the *Aëdine* subgenera *Conopstegus*, *Finlays*, *Howardina*, and *Stegomyia* are day fliers. The other *Aëdine* subgenera and the genus *Psorophora* fly and attack readily by day but preferably at twilight, the Anophelines more especially at twilight, and those of *Culex* during twilight and night hours. *Mansonia titillans*, and probably the other species of *Mansonia* as well, are apparently on the wing at all hours of the day and night, providing the weather is favorable. There are exceptions to these generalizations, in that stegomyia sometimes attack at night and various species of Anophelines (subgenera *Stethomyia* and *Nyssorhynchus*) will occasionally bite in direct sunlight.

Indoors, the time of mosquito attacks is of importance in helping to determine the species concerned. Stegomyia attack during the day, culex at night; but during twilight hours these, as well as the suburban species of *Aëdes*, *Mansonia* and *Anophelines*, may all join forces.

SUMMARY.

Approximately ninety species of mosquito have been found in the middle coast states of Brazil. Owng to the comparatively less favorable climate of this area, the fauna is not as rich in species or as prolific in individuals as in the more humid regions of the Amazon and of several southern coast states. The larval habitat is definitely known for all but seven of the species, and in these cases the habitat may easily be inferred from the group relation of the species.

Mosquito environment is treated (A) according to the biology of the mosquitoes and (B) as affected by the environment of man. Under (A) it is shown that the larvae of each species are more or less restricted to a special type of habitat and, further, that the natural classification of the habitats is in accord with the natural (phylogenetic) classification of the family. The larval

habitats are classified according to location and condition. For the majority of the species, the location, whether in ground deposits or in containers (natural or artificial) on or above ground, is of primary importance; while the condition of the water appears to be of primary importance only in the case of a few species of the subgenus *Culex*. The majority of the species belonging to the tribes Culicini, Uranotaeniini, and Anophelini are addicted to ground deposits of water, while the tribes Sabethini and Megarhinini, and the Culicine groups *Orthopodomyia*, *Haemagogus*, *Cenopstegus*, *Finlaya*, *Howardina*, *Stegomyia*, *Microculex*, and *Kerteszia* are addicted to the container type of larval habitat.

Under (B) the mosquitoes are grouped in accordance with their ability to adapt themselves to man's environment. Class I contains the essentially domestic species, stegomyia and culex. They are the only species which occur in the centers of large cities, breed more or less habitually in and around human habitations, and are rarely found under sylvan conditions. When they do occur under the latter conditions, it is never more than a few hundred yards from houses. Certain experiments, in fact, in which approximately 3,000 eggs, larvae, and pupae of stegomyia were placed in woodlands three kilometers from houses, show that the adults do not remain to propagate under truly natural conditions.

The behavior of stegomyia larvae renders them easy prey to enemies. The relative absence of predators in the container type of habitat, as compared with the usually numerous enemies present in ground-water deposits, suggests that the container type was adopted by the stegomyia as a means of escape from predators; or it may be that the behavior of the larvae results from the general absence of enemies in their habitats.

Class II consists of a group of less adaptable species, which can, however, easily exist under suburban conditions. The obnoxious wild species and the malarial vectors belong here.

Class III contains the strictly sylvan species, which, because of the peculiarity of their larval habitats, quickly disappear as man encroaches upon their territory.

Acknowledgment.

It is a pleasure to acknowledge my indebtedness to the members of the Rockefeller Foundation yellow fever staff—Drs. N. C. Davis, A. W. Burke, E. Cardoso, W. J. Doyle, M. Frobisher, J. Serafim, and D. B. Wilson—for many observations of interest concerning the local mosquitoes. These have for the most part been included anonymously in the foregoing pages.

Bibliography.

Bourroul, C.
1904. Mosquitos do Brazil. Faculdade de Medicina da Bahia, These de Doutoremento. Bahia, Brazil.
Carter, H. R.
1924. Preferential and Compulsory Breeding-Places of *Aëdes* (*Stegomyia*) *aegypti* and Their Limits.
Ann. Trop. Med. and Parasit., 18: 493–503.
da Costa Lima, A.
1930. Sobre os mosquitos que se criam em buracos de arvores.
Mem. Inst. Oswaldo Cruz. 23: 255.
Davis, N. C.
1926. Study on the Dispersion of Resting Anopheline Mosquitoes from Dwellings in Brazil.
Amer. Jl. Hyg., 6: 23–35..
Dunn, L. H.
1927. Observations on the Oviposition of *Aëdes aegypti* Linn., in Relation to Distance from Houses.
Bull. Ent. Res. 18: 145–148.
Dunn, L. H.
1928. Further Notes on Mosquito Breeding in Tree-holes and Crab-holes.
Bull. Ent. Res. 18: 247–250.
Dyar, H. G.
1928. The Mosquitoes of the Americas.
Published by Carnegie Institution of Washington, D. C.
Gordon, R. M.
1922. Notes on the Bionomics of *Stegomyia calopus*, Meigen, in Brazil. Part II.
Ann. Trop. Med. and Parasit., 16: 425–439.
Howard, L. O., Dyar, H. G., and Knab, F.
1912. The Mosquitoes of North and Central America and the West Indies.
Published by Carnegie Institution of Washington, D. C., pp. 20-24 and p. 146.
Le Prince, J. A.
1912. Recent Progress in Anti-Malaria Work, with Special Reference to Anopheles Flight as Studied on the Isthmus of Panama.
Trans. XV, Int. Cong. Hyg. and Demag.
Pinto, C.
1930. Mosquitos da região neotropica (Brazil, S. Paulo) I.
Mem. Inst. Oswaldo Cruz. 23: 53–154.
Riqueau.
1929. Les trous de crabes, Gîtes à larves.
Bull. Soc. Path. exot., 22: 175–179.
Shannon, R. C.
Stegomyia Breeding in Bamboo. (In press.)
Shannon, R. C., Burke, A. W., and Davis, N. C.
1930. Observations on Released *Stegomyia aegypti* with Special Reference to Dispersion.
Am. Jl. Trop. Med., 10: 145–150.

SHANNON, R. C., and DAVIS, N. C.
1930. The Flight of *Stegomyia aegypti*.
Am. Jl. Tro . Med., 10: 151-156.
ZETEK, J.
1915. Behavior of *Anopheles albimanus* and *tarsimaculatus*.
Ann. Ent. Soc. Am. 8: 221-271.

A NEW SCELIONID EGG PARASITE OF THE BLACK WIDOW SPIDER.

By HERBERT L. DOZIER, *Service Technique*, *Port-au-Prince*, *Haiti*.

It is very interesting to describe a reared species of *Bæus*, from the egg mass of a specifically identified spider, and especially as its host is the generally feared, very poisonous *Latrodectus mactans*. The egg masses were placed in glass tubes for observation. Young spiders hatching at the same time did not seem to take any notice of the wingless females and these remained alive in the tube as long as eight days. Numbers of winged males, however, were found dead in four days time but were apparently not eaten by the spiders.

Bæus latrodecti, new species.

This species is nearest in coloration to *Bæus americanus* Howard but differs in the general more yellowish-orange color, particularly the head, and is slightly longer in body length.

Male.—Length, .86 mm. General color distinctly darker than the female, dark honey-orange with the dorsum of thorax and abdomen infuscated; legs honey-yellow. Antennae pale yellow, composed of eleven joints, the scape very long, much thicker and wider than the other joints, the club constricted near middle, making the club appear almost as being two-jointed. Wings hyaline, fringed, venation pale brown, marginal nervure very short, basal nervure distinct, the stigmal long and oblique, no post marginal nervure present.

Female.—Length .717 mm. Length of antennal club .115 mm.; width of club .046 mm. General color of head and body medium to dark honey-yellow, the abdomen a decidedly deeper or rusty color; eyes black; antennae honey-yellow, the basal half of pedicel fuscous; legs concolorous with the head, the last joint of tarsi blackish. Head large and broad, decidedly wider than the thorax. Pro- and mesonotum and abdomen with dark prominent setae when observed under microscope, less prominent on abdomen on account of the darker color of the latter. Antennae seven-jointed, the club very large, being slightly longer than the combined pedicel and funicle joints; funicle joints very narrow, short, transverse and subequal. Abdomen robust, rounded, distinctly wider than the thorax.

Allotype wingless female mounted in balsam on slide, U. S. National Museum Cat. No. 43327. Holotype winged male on slide with four other males and four females.

Described from two females reared October 30, 1930, and a large series of females and males reared Nov. 12-14, 1930, by the writer from egg sacs of the "cul rouge" or "black widow" spider, *Latrodectus mactans* Fab. collected from beneath bee hives at Damien, Haiti.

Ashmead in the description of the winged male of *Bæus americanus* How. and characterization of the genus, states that the male antenna is 12-jointed but with the male of *B. latrodecti* there are only eleven joints, the last being constricted somewhat to suggest a twelfth joint.

Actual date of publication, February 9, 1931.

PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 33 FEBRUARY, 1931 No. 2

BIOLOGICAL OBSERVATIONS ON AGRIOTYPUS (HYMENOPTERA).

By CURTIS P. CLAUSEN,

Bureau of Entomology, United States Department of Agriculture.

The ichneumonoid family Agriotypidae, of which only a single species (*Agriotypus armatus* Curtis) has heretofore been known, has engaged the interest of insect parasitologists for many years owing to its aquatic habit as a parasite in the cases of caddis-flies. The species was described by Curtis, who, in 1832, noted its aquatic habit, and in 1858 von Siëbold called attention to its rôle in relation to the caddis-fly cases. In 1889 and 1893, Klapálek (*2*, *3*) published accounts of the general habits of the species and described and figured the mature larva, the "subnymph," the pupa, and also the peculiar ribbon formed at the end of the parasitized cases. This species is found in many of the countries of Europe and is recorded as having been reared from the cases of the genera *Silo*, *Geora*, *Odontocerum*, *Aspatherium*, and *Trichostoma*.

In Japan, Ota observed a species of the genus parasitic in caddis-fly cases in Lake Hakone, and in 1917–1918 (*4*, *5*) published accounts of his observations. The data and figures given are in all essential respects similar to those of Klapálek, and no additional information was presented. Ota believed this species to be distinct from *armatus*, but did not describe it.

In the early spring of 1929 the writer made a collection of caddis-fly cases at Lake Hakone, bearing the filament indicative of Agriotypus attack, and reared out the adults. A series of these was sent to Dr. J. Waterston at the British Musem for examination and comparison with the types of *armatus*, and he has recently described the species as new under the name of *Agriotypus gracilis* (*6*).

This paper deals with the habits of the adult, the manner of oviposition, the egg, and the first larval stages, with notes on the mature larva as interpreted from an examination of the cast skins. Regrettably, the writer's departure from Japan prevented the completion of the study of the life history of this most interesting parasite.

On March 25, 1929, a search was made for parasitized cases

and a total of 21 of these secured. They were found largely in the crevices of the stone embankment bordering the lake along the village front, usually from 6 to 15 inches beneath the water level prevailing at that time, and were readily distinguished by the long ribbon-like appendage extending out into the water from the anterior end of the case. The collections were made between 10 and 11 o'clock in the morning, and 13 females and 6 males of *A. gracilis* emerged from these cases within two hours after collection. The remaining two cases were already empty. The immediate emergence of these adults was probably induced by the higher temperature of the water in the glass jar in which the cases were placed, and under normal conditions in the lake this might have been delayed for a considerable time.

Mating of the reared individuals occurred very readily on the surface of the water and in vials, immediately after emergence. The females were then set aside for a week or more to permit of the maturing of the eggs, though this may not have been necessary, as the dissection of one female on the day of emergence revealed from 30 to 35 apparently mature eggs in the ovaries. For experimentation in the manner of oviposition a glass bowl 12 inches in diameter and 5 inches deep was used, a layer of sand and gravel being placed in the bottom with a few tufts of grass at one side, and filled with water for a depth of 4 inches. About 50 caddis-fly cases containing active larvae, prepupae, and pupae were then placed in the bowl.

Under proper conditions the females would descend into the water by means of the grass stems and leaves provided for that purpose, and no instance of unaided direct entry was observed. Under the conditions as they exist in the collection locality at Lake Hakone the only means of getting beneath the surface is by crawling down the face of the stone embankment or the sides of occasional partially submerged rocks. In the laboratory this was most easily induced by dropping the females upon the surface of the water and then forcing them beneath it by the use of a small brush. Once submerged and brought into contact with pebbles or other objects which could be grasped with the feet, they would remain there and soon begin the search for host cases.

Upon entrance into the water, the entire body is enveloped by a bubble of air which conforms in general to the body outline, and the formation of this is probably due to a considerable extent to the fine, dense pubescence with which the body is clothed. The antennae are usually laid back over the thorax and held there by the air bubble, while the wings remain folded in the normal resting position. The respiratory requirements of the female during the period of submergence are partially met by the bubble contents, and this supplemented by oxygen

entering the bubble from the surrounding water. In no instance has any activity with the antennae been noted under water, and they are evidently functionless in so far as the detection and examination of the host is concerned.

The maximum period during which a female was observed to remain under water continuously was 14 minutes, though the average was considerably less. In emerging from the water the foothold upon the object beneath is first loosened and the body then quickly floats to the surface, there being no movement of either the legs or wings at this time. Ota states that they swim obliquely to the surface, with the wings folded. Upon reaching the surface of the water the film is broken without difficulty, and the parasite may take flight immediately. Other individuals will coast on the water for several inches or more in gaining speed before taking wing. During this preliminary coasting, the wings beat rapidly as in flight; the middle and hind legs trail on the surface of the water, and the anterior pair is held sharply raised, with the tarsi directed downwards.

In the examination of caddis-fly cases preparatory to oviposition the female is evidently guided by the tactile sense, the stimuli being transmitted through the feet or by movements of the host transmitted through the water to the sense organs. She may walk about over a case for a considerable time or may immediately insert the ovipositor. While able to distinguish readily whether or not a case is inhabited, she can not recognize the stage of caddis-fly contained therein. Provided the host case is inhabited, the female parasite lowers the tip of the abdomen and feels about with it until a suitable crevice is found between the bits of sand or gravel covering the outside of the case, following which its perforation with the ovipositor is attempted. This may happen a number of times and at different points before actual penetration is accomplished, and the point finally chosen is usually in the mid-dorsal region somewhat to one side of the median line.

Should the case contain an active caddis-fly larva the first jab of the ovipositor of the parasite causes it quickly to extrude the head and the thoracic segments from the anterior opening of the case. As a result of this response the parasite immediately withdraws the ovipositor and leaves the case without oviposition. Not a single egg was deposited in the one hundred or more instances in which the perforation of the cases of active larvae was observed.

The attempt to effect oviposition upon mature larvae having failed, attention was turned to the prepupae and newly-formed pupae. The former is entirely immobile in the case and the latter capable of moving the abdomen to only a limited extent. The anterior opening of the case is closed and it is firmly attached to stones or in crevices in embankments. Penetration

of these cases was effected in exactly the same manner as with the larvae, and the egg laid externally upon either stage. The entire process of oviposition usually covers a period of from 3 to 5 minutes.

The establishment of the fact that oviposition occurs externally upon the prepupa and the pupa, rather than internally in the mature larva, was an unexpected development. Klapálek in the case of *armatus*, and Ota in *gracilis*, have both stated that the mature larval stage is attacked. While Klapálik does not state definitely that *armatus* is an internal parasite, yet various writers have assumed such to be the case.

The ovarian egg is 0.9 mm. in length and 0.18 mm. in maximum width, this being near the anterior end; the ventral surface is nearly straight and the dorsal slightly convex, with the anterior end smoothly rounded and the posterior somewhat tapering. There is no indication of any structure corresponding to a pedicel. Over the anterior end is a marked increase in the thickness of the egg covering, which appears to be distinct from the chorion proper.

The laid egg is of approximately the same dimensions and form as the ovarian egg but, strangely enough, is found with a distinct stalk 0.20–0.25 mm. in length, by means of which it is anchored to the host derm. This stalk differs from that of the eggs of other Ichneumonoidea which are attached to the host body in a similar manner in that it is of inconstant form and is not an extension of the egg chorion. Both the stalk and its enlarged tip, which is inserted beneath the host derm, become almost black and have a shrivelled, twisted appearance shortly after the egg is laid, an effect not seen in other stalked ichneumonoid eggs. It appears that this stalk must be formed at the time of oviposition, from the sheath of material which closely envelops the anterior pole of the ovarian egg. The chorion of the egg is of a very light amber color and is exceedingly tough, being difficult of penetration even with a sharp dissecting needle.

The position of the egg on the host body is usually lateral or dorso-lateral, either on the thorax or on the anterior half of the abdomen of the prepupa or pupa, and often in one of the intersegmental grooves. Several instances were noted of eggs attached to the wing pads of pupae.

During the latter part of the incubation period the form of the developing larva within the egg can be readily distinguished. The large bifurcate caudal process lies ventral of the body, the prongs being contiguous, and extends forward to the posterior margin of the head.

At the time of hatching there first appears a small break in the chorion beneath the posterior half of the head and the first thoracic segment. Whether this is effected by the use of the

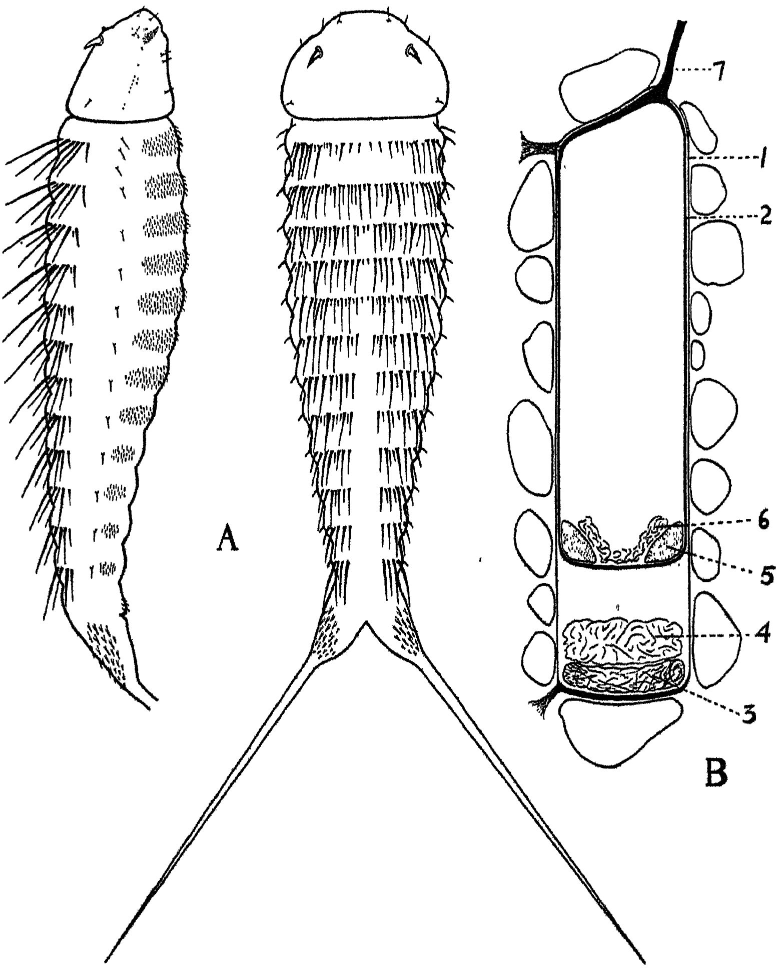
mandibles of the larva is not known. The enlargement of the aperture is accomplished by a slow but steady distension of the thoracic region of the body and the consequent bringing forward of the posterior portions. This continued outward pressure results gradually in a broadening of the aperture until the thoracic segments are forced through it, the head at this time being still within the egg and bent back over the dorsum. Further enlargement of the circular opening frees the head, following which the entire body slowly emerges. The opening through which emergence is effected is about two-thirds the width of the egg, circular in outline, and with the edges curled back. There is no splitting of the chorion such as is seen in the hatching of other ichneumonoid eggs. The time elapsing from the first indication of a break in the chorion to complete emergence of the larva is five to eight hours.

Agriotypus gracilis Waterston: A, dorsal and lateral views of first stage larva; B, longitudinal section of parasitized case showing (1) the caddis-fly case, (2) the Agriotypus cocoon, (3) the cast larval skin of the caddis-fly, (4) the pupal remains of same, (5) the meconial ring of Agriotypus, (6) the cast larval skin of same and (7) the basal portion of the silken ribbon extending outwards from the anterior end.

The first stage larva (A) is 1.2 mm. in length to the base of the bifurcate caudal process, 0.35 mm. in width in the thoracic region, with 13 body segments and translucent white. There is no trace of open spiracles.

The head is as broad as the thoracic segments, the length being slightly less than the width. Dorsolaterally, and slightly forward of the transverse median line, is a pair of heavy horn-like processes similar to those seen on a *Perilampus* planidium. There are 7 pairs of fine setae, situated as shown in the illustrations. The pharyngeal skeleton is irregularly U-shaped, with the heavy mandibles simple.

Each of the body segments, except the last, bears dorsally a median transverse row of heavy spines extending nearly to the lateral margins. On the first five segments the row is continuous across the dorsum, while on the following segments it is interrupted along the median line. These spines are of very unequal length, the largest being slightly longer than the segment itself, and situated near the ends of the row. At the lateral margin of the first segment are two small spines, and one only on the following eleven segments. The first eight segments each bear ventrally a broad band of closely set setae extending nearly to the lateral margins. The anterior and posterior margins of each segment are bare. On segments 9 to 12 this band is broken medially. The caudal segment is bifurcate, with its 2 prongs 0.9 mm. in length, very slender, heavily chitinized and sharply pointed, diverging at an angle of about 80 degrees and borne at an angle of approximately 45 degrees with the horizontal plane of the body. The dorso-lateral area at the expanded base of the process bears numerous short, robust setae. Ventrally, there is an indication of the anal opening.



The bifurcate caudal process reveals a considerable similarity to that of the primary larva of *Anastatus albitarsis* (*1*), which develops in the egg of *Dictyoploca japonica.* In the latter case the transverse rows of heavy spines on the body segments are borne ventrally rather than dorsally, and these, in conjunction with the caudal process, permit of some degree of movement in the semifluid contents of the egg through a flexing and straightening out of the body.

The above type of larva, unique among the ichneumonoid Hymenoptera, is exceptionally well adapted to the conditions under which it lives. The dorsal rows of heavy spines, which normally lie flat on the body, can be raised to a nearly vertical

position, and these, in conjunction with the ventrally directed caudal process, permit of ready movement between two curved surfaces such as exist in the caddis-fly case between the body of the prepupa or pupa and the wall of the case. The larva has three points of contact with the surface upon which it rests, these being the head and the tips of the two caudal prongs. In movement the posterior portions of the body are raised and the tips of the prongs brought forward. The dorsal rows of spines, in contact with the cocoon wall, serve to prevent backward movement through any cause. Being thus braced, the head is then moved forward and the action repeated.

At first sight, it would appear surprising in a highly specialized larva such as this, and of aquatic habit, that none of the morphological modifications has any relation to respiration. They are solely locomotory in function, and no open tracheal system exists. However, in its life in flowing water, the environment is really more comparable to that of a normal internal parasite floating in the body fluids of its host than to an external one in the open air. It is probable that the supply of oxygen required is secured partially by osmotic action from the surrounding water and to a lesser extent from the body fluids of the host which are imbibed. In an open Petri dish several of these larvae lived in ordinary tap water for 3 to 5 days, a period much longer than has been found possible even in normal saline solution with other primary larvae of internal habit.

The final larval stage differs very little from the ordinary ichneumonoid form. Living or preserved specimens have not been available for examination, and the few details given are based upon the cast skins found in cocoons from which the adults had already emerged.

The head capsule is relatively large and is quite heavily pigmented in irregular areas. The segmentation of the body is distinct, and nine pairs of open spiracles are present. The caudal segment bears a broadly bifurcate process, approximately equal in length to the last two segments, the ends of the prongs being curved slightly inward toward the median line and the tips somewhat dilated and rounded rather than sharply pointed.

In the empty host cocoons there were found no cast skins corresponding to the "subnymphal" described and figured by Klapálek, and Ota does not mention having seen such a form in *A. gracilis*.

The most interesting point in the life history of Agriotypus is the formation and function of the elongate, whitish, ribbon-like band which extends outwards, at times to a length of 2 inches or more, from the anterior end of the cocoon and floats freely about in the water. Ota surmises that it serves as a warning signal to enemies or as a scaffolding for use at the time of emergence, but there is little to support either idea.

This ribbon is unquestionably a component part of the Agriotypus cocoon, and is presumably formed by the mature larva at about the same time. It appears to consist of a bundle of silken strands rather loosely bound together, and attached to the cocoon dorsally at the anterior end. In the material examined there was no indication that this ribbon represented a hollow tube, as was at first supposed.

A consideration of the conditions under which the mature larva and pupa live in the cocoon indicates that this ribbon is associated with the respiratory function of these stages. The living larva and pupa of the host maintain a continuous flow of water through the case, and thus the first larval stage of the parasite, and presumably the intermediate also, derive their oxygen supply from the water in the same manner as does the host. In the final larval stage, however, the host is destroyed, and the parasite is equipped with a fully developed and open tracheal system, necessitating existence in air rather than in water. The Agriotypus cocoon, spun inside that of the host, is quite heavy, completely closed, and impervious to water. Thus the supply of oxygen, previously derived direct from the water, is shut off. An examination of the previously mentioned ribbon indicates that between the silken strands may be numerous minute air channels extending into the cocoon, and that the oxygen in the surrounding water might be drawn into these channels and into the cocoon owing to a lower air pressure within.

In Fig. B is shown a longitudinal section of a caddis-fly pupal case containing the cocoon of Agriotypus. The case of the host is relatively light in texture and is closed at both ends. At its posterior end is seen the cast skin of the caddis-fly larva (3) and the remains of the pupa (4), each as an irregular pad. The cocoon of Agriotypus is considerably heavier and occupies only about three-fourths of the space available, the posterior region containing the host remains being partitioned off. The ends of the Agriotypus case are considerably heavier than the sides, and from the anterior dorsal edge extends the long silken ribbon (1) of nearly the same width as the cocoon, which identifies all parasitized caddis-fly cases. At the base of the cocoon the larval meconium (5) is found as a ring encircling the tip of the abdomen of the pupa, while the larval exuvium (6) forms a conical sheath about it.

Literature Cited.

1. Clausen, Curtis P.
1927. The Bionomics of *Anastatus albitarsis* Ashm., parasitic in the eggs of *Dictyoploca japonica* Moore (Hymen.) Ann Ent. Soc. Amer., 20 4, pp. 461–473, 1 pl.

2. KLAPÁLEK, K.
1889. *Agriotypus armatus* (Walker) Curtis; its life history and geographical distribution. Ent. Mo. Mag., 25, pp. 339–343.
3. —— ——
1893. Untersuchungen über die Fauna der Gewässer Bohmens. Arch. Landesdurchforschg. Bohem. 8, 6, pp. 52–54. Prague.
4. OTA, N.
1917. Observations on a Species of *Agriotypus* at Ashinoko. Konchu Sekai, 21,12, pp. 489–494, 1 pl., 2 figs. Gifu, Japan.
5. —— ——
1918. On a Species of Agriotypidae from Japan. Zool. Mag., 29, pp. 281–285, 12 figs. Tokyo.
6. Waterston, J.
1930. Two New Parasitic Hymenoptera. Ann. Mag. Nat. Hist., Ser. 10, 5, pp. 243–246.

BRUCHIDAE INFESTING SEEDS OF COMPOSITAE, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES (COLEOPTERA.)

By JOHN COLBURN BRIDWELL, *Washington, D. C.*

For some thirty-two years a major task of our Department of Agriculture has been the exploration of all parts of the world for new plants adaptable to our agriculture. Up to the present time some ninety thousand lots of seeds and plants have been handled by the Office of Plant Introduction. This work has established the cultivation in this country of durum wheat and of the soybean, to mention two strikingly beneficial results. Nearly half of these lots consisted of seeds of which samples have been preserved in a seed collection in charge of H. C. Skeels. This seed collection now contains samples of seeds of more than twelve thousand species of plants and it is safe to say constitutes the greatest collection of seeds of economic plants in existence.

The infestation of these seeds by insects was early noted by the men in charge of this work and the insects noticed began to accumulate in the National Museum and in the Chittenden collection in the Bureau of Entomology (now in the Museum). After the establishment of the Federal Horticultural Board in 1912, all the material imported by the Office of Plant Introduction was subjected to rigorous inspection by the Port Quarantine Division of the Board and the insects intercepted sent by the Bureau of Entomology to the Museum for identification by the specialists of the Bureau.

On account of their agricultural importance, the legumes make up one-fourth of the seed collection and the Bruchidae which

infest seeds of this family have formed a large proportion of the insects intercepted. Some fifty museum drawers of these insects are now present in the Museum, many of them from material intercepted by the Federal Horticultural Board in seeds imported by the Office of Plant Introduction. Much of this material is accompanied by notes indicating the host seeds affected and is in many instances accompanied by the seeds from which they had emerged and constitutes the most important source of recorded but unpublished information on the habits of Bruchidae in existence. While a great majority of the Bruchidae of which the larval habits are known live in the seeds of legumes—Viciaceae, Cassiaceae, and Mimosaceae—many other plants are utilized. Whole genera of Bruchidae devote their attention to plants of other families. The palm bruchids have been the subject of a recent paper. In another, attention has been directed to the genus *Megacerus* with its species attached to plants of the family Convolvulaceae. In the Old World most of the species of *Spermophagus* use seeds of the same family; a few attack Malvaceae, while only a single species is known to affect the seeds of a legume—a species of *Cassia*. In the New World several species in different genera devote themselves to the Malvaceae. Besides these, material in the National Museum ndicates the use of seeds of these plant families: Lauraceae, Rhamnaceae, Tiliaceae, Bixaceae, Epilobiaceae (Onagraceae), Anacardiaceae, and Dioscoriaceae. In Europe one of the bruchids lives as a larva in the stems of an Umbellifer. To these varied host plants we may now add the Compositae.

The only published indication that bruchid larvae can live in the seeds of composites which I have encountered is found in the description of *Bruchus lapsanae* Motschulsky 1874 Bull. Soc. Nat. Moscou 46^2 : 235 where the species is said to be from "Panama in sem. [inibus] *Lapsanae.*" Since the cichoriaceous genus *Lapsana* (sometimes written *Lampsana*) is native to the Palaearctic region with its described species ranging from Europe and the Mediterranean region to Japan, there must be some error of host plant or locality. Cichoriaceae seem to be almost absent from Central America. The description of this species, which has not since been recognized, shows that it is not similar to the other species here discussed.

H. Y. Gouldman, of the Federal Horticultural Board, found a pair (♀ and ♂) of a peculiar bruchid among the seeds of the tree Dahlia (*Dahlia maxonii* Safford) on March 23, 1920, in quarantine at Washington, D. C., collected by Wilson Popenoe at Antigua, Guatemala, on February 20, 1920 (S. P. I. 49757; F. H. B. 29942). These insects were examined by the writer in 1921 and were recognized as representing an undescribed genus of Bruchidae, but were not determined specifically. On March 16, 1923, Mr. Gouldman collected from seeds of the same host

plant a series of the same insect which the late Dr. E. A. Schwarz determined as *Bruchus longulus* Sharp 1885 (described from Nicaragua). These seeds were sent to the Office of Seed and Plant Introduction by W. Cameron Townsend from Chimaltenango, Guatemala (S. P. I. 56665; F. H. B. 345288). Recent examination of the seed of this sending preserved in the Seed Collection revealed an additional adult loose in the containing vial, another within a seed, a crushed pupa in a seed, and a number of the achenes showed emergence holes from which adults had escaped. These were not quite so neatly cut as is usual with Bruchidae, doubtless because of the fibrous nature of the covering of the seed. No trace of eggs could be found. We may then be sure that these seeds nourished the larvae from which the adult bruchids had developed. I have seen the types of *Bruchus longulus* and am convinced that Dr. Schwarz's determination is correct, but unfortunately the specific name is preoccupied in *Bruchus* and must be replaced. Dr. Sharp's figure of the species gives an impression of greater narrowing of the prothorax anteriorly than is really found.

A lot of seeds of an undetermined *Dahlia* resembling the horticultural *Dahlia*, from the Federal District of Mexico sent by William Brockway and received in Washington on September 22, 1913 (S. P. I. 36257) showed similar emergence holes in the achenes and indicate the presence of a *Dahlia* bruchid in that locality, but it still remains to be determined if it is the species described below or the Nicaraguan species or some other species still unknown.

There is in the United States National Museum a single male bruchid collected by Leopold Conradt in the Federal District of Mexico so closely related to the Nicaraguan *Dahlia* bruchid as to suggest that it may be the Mexican *Dahlia* bruchid but no accompanying notes are present to confirm this. It is congeneric with the Nicaraguan species and is described below.

Paul G. Russell of the Office of Foreign Plant Introduction collected a pair of a peculiar bruchid upon the flowers of *Cosmos* sp. at Oaxaca, Mexico, on September 29, 1930, which, from its affinity to the *Dahlia* bruchids, may be expected to breed in the seeds of the *Cosmos* upon which it was found. *Cosmos* belongs in the same tribe of the Asteraceae as *Dahlia*, *Coreopsis*, and *Bidens*. The seeds of the garden *Cosmos* seem to be too small and narrow to support a bruchid larva, but other species of possible horticultural value have seeds large enough to serve this use. This bruchid is closely allied to the other two here discussed, but differs so much in important characters as to make it desirable to place it in a genus distinct from them.

DAHLIBRUCHUS, new genus.

Genotype *Dahlibruchus sharpianus* new name *Bruchus longulus* Sharp 1885, Biologia Centrali Americana Col. 5: 482, not Kraatz 1868.

Body elongate, about twice as long as broad and twice as broad as deep; head short, eyes emarginate more than one half, separated by the width of the eye or more, head strongly contracted beneath and on the sides but not above behind the eyes, temples abruptly declivous to the contraction; antennae short, compressed, perfoliate-clavate, joints 1–4 narrow, 5 and 6 gradually broader, 7–10 expanded, as broad as long or broader, 11 ovate; pronotum subquadrate with anterior angles rounded, dorsum little convex, surface even, median lobe slightly impressed medially, posterior angles a little acute, lateral margin acute, carinate posteriorly to the middle, ampliate in the middle, obsolete anteriorly, flanks broadly concave posteriorly; prosternum acute at apex, separating the coxae for about one half their length; mesepimeron lance-ovate, acuminate toward the coxa but remote from it; mesosternum oblique, narrowy truncate at apex, overlapping the apex of the metasternum; scutellum small, subquadrate, emarginately bidentate at apex; elytra conjointly much longer than broad, nearly three times as long as the pronotum, slightly broader at base than the prothorax, gradually broader posteriorly to beyond the middle, surface even, without tubercles at base, not much convex (not at all longitudinally), striae fine, impressed, without visible punctures, free at apex, 5 and 6 abbreviate at apex, intervals flat, humeral callus and humeral lobe feeble, apices covering the pygidium at base; legs with all the femora somewhat incrassate; hind femur as wide as the coxa, nearly straight beneath, widest in the middle, lower side somewhat flattened, without carinae, teeth or denticles, condylar plates small and rounded, hind tibia straight except at base, gradually widened to apex, truncate at apex with apical teeth or spines, hind tarsus about as long as hind tibia, basitarsus about half as long, slightly arcuately arched, not produced at apex beneath, ungues appendiculate with the basal lobe a little acute, abdomen about as long as the thorax, longer than broad, first sternite behind the coxa longer than the coxal width and longer than sternite 2, but not as long as 2 and 3 together, intermediate sternites longer than usual, sternite 5 in ♂ very slighty broadly emarginate and longer in the middle than sternite 4, in the ♀ about as long as 3 and 4 together; pygidium subhorizontal, about as broad as long, broadly rounded at apex, subplane more convex and deflected at apex in the ♂.

I have seen no species of Bruchidae approaching in form the two species placed in *Dahlibruchus* excepting the species described below as *Cosmobruchus russelli*, which is still more elongate and more nearly cylindrical with the hind femur dentate beneath and hind tibia unarmed at apex. *Bruchidius longulus* Schilsky 1905 (Kafer Europa's 41: no. 79) described from France, Spain, Greece, and Asia Minor, must approach the species of this genus in form but has the hind femur with a fine denticle near apex beneath and the antennae serrate in the ♂ and subserrate in the ♀. Nothing is recorded as to the host-plant of this species.

The two species of Dahlibruchus may be distinguished thus:

Front finely carinate; sides of pronotum slightly convergent anteriorly; front tibiae ♂ with an erect acute tooth at middle beneath ♀ unknown
conradti, new species.

Front flat, without any indication of a carina; sides of pronotum not at all convergent; front tibiae unarmed in both sexes.
sharpianus, new name.
Bruchus longulus Sharp 1885.

Dahlibruchus conradti, new species.

Black, antennal joints 1–4 (1 and 2 blackish above) and legs red, the hind femora suffused with black to about the middle; with appressed cinereous pubescence somewhat concealing the surface scuplture (much abraded in the type); pronotum somewhat longer than in *sharpianus* with moderate punctures separated by the width of one to three punctures, antennae longer than in *sharpianus*, third joint much longer than 2 or 4, 7–10 about as broad as long; front tibia with a strong acute erect tooth in the middle, and somewhat sinuately narrowed beyond the tooth; hind tibia with the apical armature made up of triangular teeth rather than spines (spiniform in *sharpianus*), the ventral tooth (mucro) not longer than the lateral tooth, pygidium less oblique and less convex than in *sharpianus* ♂, but suddenly bent down near apex. Length (apex of pronotum to apex of elytra) 2.5 mm.; width of elytra 1.25 mm.; depth .75 mm.

Described from a single ♂ type collected in the Federal District of Mexico by Leopold Conradt. The female is unknown.

COSMOBRUCHUS, new genus.

Genotype *Cosmobruchus russelli*, new species.

Closely related to *Dahlibruchus* and similar to it in many of its characters, but still more elongate in form, nearly or quite three times as long as broad, subcylindrical instead of flattened, the depth being as great as the width instead of only half as great; elytra with striae 4 and 5 abbreviate at apex (instead of 5 and 6); hind femur with a strong flattened triangular tooth near apex beneath within, from which a fine carina extends forward for some distance; hind tibiae without apical teeth or spines; pygidium and hypopygium alike in the sexes, pygidium three-fourths as broad as long, abdomen longer than the thorax.

The species described below is the only known species.

Cosmobruchus russelli, new species.

Black, antennal joints 1–5 and legs yellow-testaceous, femora blackish from base nearly to middle in ♀, beyond the middle in ♂; covered with appressed pubescence, white on the body beneath and but little concealing the surface but more condensed on the sides, above yellowish cinereous, somewhat conceal-

ing the sculpture; clypeus, front and neck rugosely and subconfluently punctured with punctures finer than those of pronotum, front subtectiform with a median longitudinal impunctate shining line; pronotum closely punctured with coarse shallow punctures often separated by less than the width of a puncture, intervals of elytra without punctures except for the usual microscopic punctulation of the surface in general; punctures of pygidium very shallow.

Length ♀ (apex of pronotum to apex of elytra) 2 mm.; width of elytra 1 mm.; depth 1 mm. Male about five-sixths as large.

Described from 1 ♀ type and 1 ♂ allotype collected by P. G. Russell, at Oaxaca, Oaxaca, Mexico, September 29, 1930, on the flowers of *Cosmos* sp.

The two genera here described belong in the subfamily Bruchinae, the largest complex within the family. Only a small number of genera in which they have differentiated are as yet distinguished. Their affinities are with American forms.

The form in these interesting species is with little doubt due to the shape of the achenes in which they pass their immature stages. The *Dahlia* achenes are flattened and elongate while those of *Cosmos* are nearly circular in cross section. I believe this principle governs the shape of many Bruchidae. Those species which are limited to hosts with flattened seeds tend to a flattened form while those which breed exclusively in seeds more nearly spherical assume a more compact form. Those not confined to seeds of the same form do not seem to be much affected by the shape of the host seed, but even here there is some reason to believe that some individuals are actually more depressed in form than others of the same species from pressure upon them during development.

A NEW LEAF MINING BUPRESTID FROM THE CANAL ZONE (COLEOPTERA).

By W. S. Fisher,
Bureau of Entomology, United States Department of Agriculture.

Pachyschelus psychotriae, new species.

Male.—Broadly ovate, slightly longer than wide, more strongly narrowed behind than in front, strongly shining, sparsely pubescent, the pubescence forming more or less distinct fasciae on the elytra; head and pronotum aureo-aeneous; scutellum piceous, with a feeble violaceous tinge in certain lights; elytra cyaneous, with a distinct violaceous tinge; beneath piceous, except the tarsal lamellae, which are brownish white.

Head strongly convex, with a distinct, narrow, longitudinal groove on the front; surface finely, densely granulose, with a few coarse, irregularly distributed punctures intermixed, and sparsely clothed on the occiput with short, inconspicuous hairs.

Pronotum slightly convex, four and one-half times as wide as long at middle, much narrower at apex than at base, and widest at base; sides feebly, arcuately rounded from base to anterior angles, which are rather acute; hind angles acute, projecting slightly beyond the humeral angles of the elytra and fitting closely to them; anterior margin deeply, arcuately emarginate; base transversely sinuate, and broadly, transversely truncate in front of scutellum; surface even, not depressed toward the sides, densely, finely granulose, sparsely, vaguely ocellate-punctate, and sparsely clothed with short, inconspicuous, semierect, cinereous hairs. Scutellum broadly triangular, twice as wide as long, and the surface nearly smooth.

Elytra as wide as pronotum at base, and widest at basal fourth; humeral angles broadly rounded; sides broadly rounded from base to near middle, then strongly, arcuately narrowed to the tips, which are conjointly broadly rounded, the lateral margins smooth, and when viewed from the side are nearly straight from base to apex, except for a broad, arcuate sinuation for the posterior legs; each elytron with a deep depression between the humerus and lateral margin, extending along the margin from humeral angle to middle, becoming deeper and broadly expanded behind the humerus, but without a distinct basal depression; surface coarsely, irregularly punctate, somewhat rugose, sparsely irregularly clothed with moderately long, recumbent, cinereous hairs, which form a more or less distinct, broad, transverse fascia at middle, a similar fascia covering the apical fourth, and with numerous, irregularly distributed, cinereous hairs on basal third.

Abdomen beneath feebly convex, finely, densely granulose, sparsely, coarsely, irregularly punctate, and very sparsely clothed with short, inconspicuous hairs; last segment acutely rounded at apex, the portion in front of marginal groove acutely rounded, with a rounded tubercle at apex. Metasternum very broadly emarginate in front. Prosternum feebly, broadly, arcuately emarginate in front; prosternal process very broad, the sides nearly parallel, and very broadly subtruncate at apex. Prothoracic epipleura broad and nearly flat. Antennal groove deep, wider internally, and parallel with the lateral margin.

Length, 2.6 mm.; width, 2 mm.

Type locality.—Barro Colorado Island, Canal Zone.

Type.—Cat. No. 43329, United States National Museum.

Described from a unique male cut from a larval mine in *Psychotria carthaginensis* Jacq., collected at the type locality, April 10, 1929, by S. W. Frost.

This species resembles *festivus* Fisher, but that species differs from *psychotriae* in being more slender, the pronotum more shining and not granulose, and *festivus* should be placed in the genus *Hylaeogena* Obenberger.

LIST OF MOSQUITOES COLLECTED IN NIGERIA, WEST AFRICA, INCIDENTAL TO RESEARCH ON YELLOW FEVER.[1]

By CORNELIUS B. PHILIP

Certain investigations in connection with the study of endemic yellow fever in West Africa necessitated the collection of various species of mosquitoes in the immature and adult stages. Adult insects were captured from a number of environments, during studies of local mosquito prevalence, usually by means of a "sucker" operated by sharp intake of the breath through a rubber tube connecting with a catching-chamber as described elsewhere (Phillip, 1931). This method facilitated capture and preservation of specimens for identification with a minimum of damage. Crab-holes, tree-holes, native and European quarters, undergrowth either near the compounds or bordering various aquatic environments, and the dense "bush" itself furnished the chief sources for adult mosquito collections.

Larvae and pupae were taken particularly for use in the attempted transmission of the virus of yellow fever in the laboratory. A summary of this work was recently published in Science (Philip, 1930). As a matter of interest, the species in the following table, which have been experimentally implicated in the transmission of yellow fever, have been printed in small capital type. Most of the collections of the immature stages were taken either from such natural sources as crab-holes, tree-holes, brackish water along the lagoons, various types of ponds and borrow-pits, and a few streams, or from several kinds of artificial "aquaria" such as domestic utensils, ceremonial pots, and canoes.

The exigencies of other laboratory investigations and routine precluded any more thorough investigation of the ecological phases of local mosquito prevalence than a qualitative sampling of conditions most likely to be of importance in connection with the major problem in hand. Considerable work has already been done in recording the Nigerian mosquito fauna (Graham, Dalziel, Connal and others), but a number of new records for that colony and even for West Africa, produced under other methods of sampling than were previously employed, as well as the large variety of species encountered during the writer's tour of a year and a half, appeared to indicate an advantage in recording the species taken.

A few species were taken only in the hinterland incidental to certain surveys by Drs. Kumm and Hayne of the West African Yellow Fever staff. The localities in which these were taken

[1]The studies and observations on which this paper is based were conducted in Lagos, Nigeria, with the support and under the auspices of the International Health Division of the Rockefeller Foundation.

have been marked with asterisks. All of the others were taken in and about Lagos or as far inland as Oshogbo and Shaki, by the writer. It should be added that quantitative notes in the list ("a" signifying abundant, "m," moderate, "s," scarce and "r," rare) refer only to the frequency with which the species came to the writer's attention and probably relate to the actual abundance only in a general way, i. e., *Taeniorhynchus uniformis* was seen by the writer only twice, and yet it is probably fairly prevalent, especially inland. Again, two species of *Banksinella*, of *Ingramia*, and *Uranotaenia philonuxia* are recorded as moderately abundant, but this would hold only under very localized conditions to which the writer paid special attention. However, this condition is true of most lists of mosquitoes in which the observer records relative abundance; insects considered by that author as common in one locality may be scarce under environmental conditions fifty feet away, while the reverse may be true of a different species which he has observed to be scarce. The crab-holes, for example, afford very restricted types of adult shelter, those in an exposed part of the same yard yielding considerably fewer mosquitoes than those in a shaded area nearby. More detailed observations of this type will be presented at another time.

Identifications were made in Lagos, supplemented, where the literature was inadequate, by shipment of specimens to London or Liverpool for study by Mr. F. W. Edwards or Miss A. M. Evans. Determinations by these workers have been listed after the appropriate species except in a few instances in which the writer's identification was confirmed. Thanks are also due Dr. S. L. M. S. Connal. The taxonomic arrangement is in accord with the latest tabulation of African species by Mr. Edwards as published by Schwetz (1927) with one exception: the genus *Mansonia* Blanch. has been substituted for *Taeniorhynchus* Arrh. The latter has been shown to be synonymous by tautonomy with *Aedes* and is accepted as such by being given subgeneric rank under *Aedes*, viz., *Aedes* (*Taeniorhynchus*) *taeniorhynchus* Wied. *Mänsonia* therefore takes precedence for inclusion of the species of the subgenera *Coquilletidea* and *Mansonioides*.

The species in the following list were taken as adults unless indicated as "reared," in which case they were secured in the larval stage and the adults obtained later in the aboratory.

ANOPHELES.

Anopheles s. str.—1. *mauritianus*, Grp. (s), 2. *obscurus*, Grunb. (r).

Myzomyia—3. *pharoensis*, Theo. (m), 4. *squamosus*, Theo. (Afuga*), 5. *rufipes*, Gough (Kano*), 6. *theileri*, Edw. (Afuga*, s), 7. *gambiae*, Giles (=*costalis*, Lw.) (a), 8. *nili*, Theo. (s), 9. *funestus*, Giles (a), 10. *marshalli*, Theo. n. var. near *moucheti* [by Evans] (r).

MEGARHINUS.

1. *aeneus*, Evans (reared, s), 2. *vrevipalpis*, Theo. (reared, m).

URANOTAENIA.

Uranotaenia s. str.—1. *bilineata* var. *fraseri*, Edw. (r), 2. *coeruleocephala*, Theo. (m), 3. *balfouri*, Theo. (reared, s), 4. *philonuxia*, Philip, n. sp. (m), 5. *caliginosa*, Philip, n. sp. (m).

Pseudoficalbia—6. *annulata*, Theo. (a), 7. *mashonaenisis*, Theo. (m), 8. *ornata*, Theo. (m.)

HODGESIA.

1. *sanguinea*, Theo. (s), 2. *nigeriae*, Edw. n. sp. (r).

HARPAGOMYIA.

1. *taeniarostris*, Theo. (r).

ERETMOPODITES.

1. CHRYSOGASTER, Graham, (m), 2. *grahami*, Edw. [by Evans from larvae] (r).

MUCIDUS.

1. *mucidus*, Karsch, (reared, r).

AEDES.

Dunnius—1. *argenteoventralis*, var. *dunni* Evans, 2. *kummi*. Edw. n. sp. [both by Edw. from reared adults, m].

Stegomyia—3. AEGYPTI, Linn. (a), 4. SIMPSONI, Theo. (Ibadan, Oshogbo, Shaki, reared, m), 5. *metallicus*, Edw. (Kano*, reared, m), 6. *apicoargenteus*, Edw. (a), 7. *dendrophilus*, Edw. [by Edw.] (reared, m), 8. *unilineatus*, Theo. (Ibadan, reared, r), 9. AFRICANUS, Theo. (m), 10. LUTEOCEPHALUS, Newst. (m), 11. VITTATUS, Big. (=*sugens*, Theo.) (Abeokuta, Ibadan, Shaki, a).

Aedimorphus—12. *simulans*, N. and C. (s), 13. STOKESI, Evans (=*apicoannulatus*, in several publications on Nigerian mosquitoes as corrected by Evans) (a), 14. *domesticus*, Theo. (s), 15. *punctothoracis*, Theo. (s), 16. *furcifer*, Edw. (Kano*) [by Edw.], 17. *rhecter*, Dyar (Kano*, recorded by Schwetz as restricted to East Africa) [by Edw.], 16. *nigricephalus*, Theo. (a), 18. *irritans*, Theo. (a), 19. *hirsutus*, Theo. (Kano* reared, m) 20. *albocephalus*, Theo. [by Edw.] (reared, s).

Banksinella—21. *punctocostalis*, Theo. (m), 22. *lineatopensus*, Ludl. (r), 23, *palpalis*, newst. (m).

Finlaya—24. *longipalpis*, Grunb. (reared, a), 25. ingrami, Edw. (reared, s).

MANSONIA.

Coquillettidea—1. *metallicus*, Theo. (s), 2. *aurites*, Theo. (s), 3. *annetti*, Theo. (m).

Mansonioides—4, AFRICANUS, Theo. (a), 5. *uniformis*, Theo. (r).

AEDOMYIA.

1. *africana*, N. L. (Ibi*, 1).

MIMOMYIA.

1. *splendens*, Theo. (s), 2. *hispida*, Theo. (r), 3. *pallida*, Edw. [by Edw., reported by Schwetz as restricted to East Africa] (1 ♀), 4. *plumosa*, Theo. (s), 5. *mimomyiaformis*, Newst. (m).

THEOBALDIA.

1. *fraseri*, Edw. (by Edw.) (larvae, Ibadan*).

FICALBIA.

Etorleptiomyia—1. *mediolineata*, Theo. [by Edw.]
Ingramia—2. *malfeyti*, Newst. (m), 3. *nigra*, Theo. (a).

LUTZIA.

1. *tigripes* var. *fusca*, Grp. (a).

CULEX.

s. str.—1. *quasigelidus*, Theo. (m) 2. *annulioris* var. *consimilis*, Newst. (m), 3. *thalassius*, Theo. (larvae, m), 4. *duttoni*, Theo. (a), 5. *pruina*, Theo. (a), 6. *univittatus*, Theo. (s), 6a. *univittatus* var. *neavi* Theo. [by Edw.] (s), 7. *fatigaus*, Wied. (s), 8. *decens*, Theo. (a), 8a. *decens* var. *unvidiosus*, Theo. (a), 8b. *decens*, n. var. [by Edw.] (r), 9. *grahami*, Theo. (s), 10. *perfidiosus*, Edw. [by Edw.] (s), 11. *perfuscous*, Edw. [by Edw.] (s), 12. *guiarti*, Blanch. [by Edw.] (s), 13. *tritaeniorhynchus*, Giles [by Edw.] (s), 14. *laurenti*, Newst. (s), 15. *philipi*, Edw. n sp. (s).
Neoculex—16. *rima*, Theo. (=*insignis*, Carter) (a), 17. *andreanus*, Edw. [by Edw.] (a).
Protomelanoconion—18. *horridus*, Edw. (=fusca, Theo.) (m).
Mochthogenes—19. *inconspicuosus*, Theo. (s).
Eumelanomyia—20. *albiventris*, Edw. (=*inconspicuosa*, Theo.) (m).
Culiciomyia—21. *nebulosus*, Theo. (a), 22. *cinerellus*, Edw. (m), 23. *cinereus*, Theo. [by Edw.] (s).

CITATIONS.

PHILIP, C. B. 1930. The experimental transmission of yellow fever by mosquitoes. Science, **71**: 614–615.

PHILIP, C. B. 1931. Two new Species of *Uranotaenia* (*Culicidae*) from Nigeria with Notes on the Genus in the Ethiopian Region. (Accepted for publication in The Bulletin of Entomological Research).

SCHWETZ, J. 1927. Synopsis des moustiques connus du Congo Belge. Revue Zoologique Africaine, **15**: 271—fascicule no. 3.

MINUTES OF THE 425TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON.

The 425th regular meeting of the Entomological Society of Washington was held at 8 P. M., Thursday, January 8, in Room 43 of the new building of the National Museum. Dr. A. C. Baker, President, presided. There were present 44 members and 32 visitors. The minutes of the 424th meeting were read, corrected, and approved. There were no reports of committees or other preliminary business.

The first communication on the regular program was given by H. S. Peters

and was entitled, "Collecting Insects Affecting Man and Animals in the West Indies." He accompanied Dr. Paul Bartsch of the National Museum on a four-months trip to the West Indies this past summer. He was sent by the Bureau of Entomology to investigate and collect insects affecting man and animals. They left Miami, Florida, on June 10, in a chartered boat, visiting the smaller islands in the southern Bahamas, then to Cuba and islands lying off the south coast. The route included the islands of the Cay Sal bank, Ragged Islands, Crooked Islands, Plana Cays, Mariguana, Caicos Islands, Turks Islands, Inagua, the south coast of Cuba from Guantanamo to Isle of Pines and islands adjacent and the Cayman Islands. They returned to Key West, Florida, on September 30 after making large collections of mosquitoes, sandflies and examining 1096 birds for ectoparasites. (Author's abstract.) A number of maps were shown and the itinerary indicated. This paper was discussed by Hyslop, Howard, Bishopp, Greene and Ewing.

The second paper on the program was presented by J. A. Hyslop, entitled "Report on the Entomological Sections of the meetings of the American Association for the Advancement of Science Held in Cleveland, Ohio, Dec. 29, 1930, to Jan. 2, 1931." The entomological meetings were held in the engineering building of the Case School of Applied Science and were extremely well attended, both the American Association of Economic Entomologists and the Entomological Society of America giving their programs before large audiences. The entomological banquet was held on the campus and was attended by approximately 300 entomologists. Dr. W. E. Britton of Connecticut was toastmaster of the evening and the guest of honor was Dr. W. J. Holland of the Carnegie Museum, Pittsburgh. Dr. Holland told of his early life and entomological experiences, and particularly stressed the importance of the place of the taxonomist in our entomological structure. The programs of the two societies were heavily crowded, totaling 114 papers, of which 72 were presented before the Economic Association. This does not include 14 papers that were presented at an evening session of the Extension Section of the American Association of Economic Entomologists, and which included a symposium on the effect of the drought of 1930 on insect populations. The attendance of American entomologists at the International Congress to be held in Paris in 1932 was stressed at the meeting and a committee on transportation and accommodations in Paris was appointed. The extreme dissatisfaction with the crowded program and the lack of opportunity for adequate discussion led to the appointment of a committee with power to prepare a modified program for the next meeting, which is to be held in New Orleans, La., during the Christmas Season of 1931. (Author's abstract.) This communication was discussed by Morrison, Howard and Rohwer.

Remarks were made on invitation of Mr. Ernesto Sanchez Estiada, of Havana, in charge of the plant quarantine work of Cuba, who expressed pleasure in being with us but referred apologetically to his poor speaking due to inadequate knowledge of the English language. He briefly discussed the communication by Mr. Peters, and also took occasion to express his thanks to various individuals for courtesies extended to him during his visit to Washington. Dr. P. N. Annand, a visitor of the U. S. Entomological Laboratory, Twin Falls, Idaho, on invitation also greeted the society. Dr. R. R. Parker, U. S. Public Health Service, Hamilton, Mont., a visitor, also on invitation discussed briefly recent work with ticks in Montana, particularly in the Bitter Root Valley and with special reference to localities in which parasites had been liberated. These remarks were commented on by Dr. Howard. Dr. T. S. Palmer, of the U. S. Biological Survey, another visitor, also on invitation made a brief address in which he referred humorously to the comparative ages of entomologists and ornithologists. His remarks were discussed by Dr. Howard.

The chair announced the recent death of Dr. J. S. Hine, of Ohio State University, Columbus, Ohio.

The meeting adjourned at 10 P. M.

J. S. WADE, *Recording Secretary.*

Actual date of publication, February 25, 1931

PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 33 MARCH, 1931 No. 3

THE PHOTOPERIODISM OF THE FIREFLY PHOTINUS PYRALIS LINN.; ITS RELATION TO THE EVENING TWILIGHT AND OTHER CONDITIONS.

By H. A. ALLARD, *U. S. Department of Agriculture, Washington, D. C.*

The light emitting specializations evolved by the fireflies have not failed to excite keen attention on the part of many biologists in the past. It is indeed a most striking endowment of the living mechanism to generate light whatever the subsequent utility of the function has become. There has been a weird trend of spontaneity in it all that baffles explanation, for there is no evidence at hand to lead one to believe that the individual or even the race was ever consciously, intentionally concerned with the evolution of photogenic accomplishments. In the fireflies' light we have, so far as known, an extremely high radiant efficiency, for there is little attendant heat produced, in contrast with our own wasteful efforts expended in light production.

Aside from the properties of this organic light, there is a variable behavior shown in its production and periodism that, with some fireflies at least, is so consistently related to certain phases of their evening activities throughout the season, as to merit some consideration.

I have long been interested in the behavior of fireflies, and several years[1] ago published a note on some peculiarities of their flight movements and flashing. The present paper is a further consideration of the same interesting behavior.

During the summer of 1930, a renewed interest led me to investigate the behavior of the common firefly, *Photinus pyralis* Linn.) rather critically, more especially to determine its relation to light intensity, temperature, and other conditions. Each day, with few exceptions, observations of the first evening appearance of the fireflies were made from June 13 to August 7, when they no longer appeared. To gain some idea of the weather conditions during this period, a standard U. S. Weather Bureau sling psychrometer was used, giving dry bulb or air

[1]"The Flight of Fireflies and the Flashing Impulse." Science, N. S., December 3, 1920.

temperature readings, and wet bulb readings for determination of relative humidities. The wet bulb readings were obtained by fastening a piece of muslin to the thermometer bulb, connecting it with a wick and wetting it with distilled water. The psychrometer was placed on a level with the grass about one-half foot from the ground. Without whirling, readings were made at the time the first fireflies appeared. A small portable Tycos Biram's Anemometer (sold by the Taylor Instrument Company of Rochester, N. Y.), was borrowed to determine wind velocity readings. This, however, was found unnecessary, since with few exceptions there was too little air movement at dusk in the protected situation where observations were made, to record. During the period of these observations wind velocity appeared to be such a negligible factor that the use of the instrument was soon abandoned.

Air temperatures and relative humidities alone were determined at the grass level, in the open, as soon as the first fireflies appeared here.

Observations were made at Lyon Park, Virginia. An area of open, exposed, unused roadway covered with a dense growth of grass, weeds and other herbage was selected, which lay just southward of an area heavily shaded by trees. A dense hedge of climbing roses bounded the area on the west.

The first appearance of the firefly is marked by a flash almost as soon as it takes wing from the herbage. The initial flight of the evening is very distinctive, being a slow, weak, uncertain drift or hovering close to the herbage from which the insect has arisen. From time to time, the insect settles downward in its seemingly aimless aerial drifting as if it were too weak to sustain its initial flight, and were going to alight. Just at this critical point when it seems that it must touch the herbage there is a lively flash, sometimes more or less prolonged, and coincident with this, a sudden sharp upward propulsion of the insect from a few inches to as much as 18 inches or more, takes place. The insect does not long remain at this higher level attained, however, but again begins the same uncertain drifting, usually losing the altitude previously gained, until the stratum of herbage is once more almost reached in its descent. There is once more a flash and the insect rises precipitately again. This is the usual behavior of these marvellous light emitting insects over all the area when the first evening flight movements have begun. As the dusk of evening deepens, there is a gradual increase in the average elevation attained above the herbage, and a noticeable tendency to depart from the slowly drifting, aimless hovering flight to a straight-forward, active flight in the direction of the higher shrubbery and trees, which is the characteristic flight-behavior of the night time. The flash, likewise,

becomes more sharp, incisive, regular and frequent. During cool evenings, with the temperature above the grass around 60° to 65° F., the insects, being cold blooded, and forced to have their own bodies take on the prevailing air temperatures, become sluggish in their movements. At such times they arise more slowly and with more difficulty, and their upward propulsion with each incident, somewhat lingering flash, is of much less magnitude. When high temperatures around 72° to 75° or higher obtain, their movements are more vigorous and swift, the upward propulsion at every flash attaining its greatest magnitude, amounting even to 18 inches or more at times. The conditions of air temperature in the early evenings are markedly reflected in the general behavior of the insects whose aerial movements pass from slow drifting here and there, to flight that is rapid, direct and apparently nicely controlled.

Since this peculiar early evening behavior is only temporary and is consistently abandoned later when the dusk has intensified, it must be looked upon as a transitional behavior arising in response to some special condition of the environment. As a matter of fact, the fireflies arise earlier in shade than in the open, and appear earlier on very cloudy evenings than on clear evenings. These accidental displacements merely advance or delay this transitional period. It has seemed to me, too, that there is less of the slow, dilatory rising and falling behavior when the fireflies arise in the deep shadows of trees. In other words, they arise here more directly, sustain their flight with more mechanized assurance, and develop the direct horizontal component more quickly.

Regardless of markedly varying temperatures and humidities at the time the beetles appear, the same distinctive behavior obtains until near the beginning of civil twilight, about half hour after sunset. As a matter of fact it begins at a higher level of temperature, as a rule, than obtained when rapid direct horizontal flight has finally become established 20 to 30 minutes later, so that it can not be looked upon as a sluggishness due to low temperatures.

There is good circumstantial evidence leading one to believe that this preliminary weak hovering flight is a response to light intensities too high to sustain normal flight activities. As the insects arise from the deeper shadows of the ground and low herbage, and a flash is followed by the sharp upward propulsion, they are likely to be exposed to a higher and more direct intensity of light from the western skies. It would appear that this condition of brightness unfavorable to active flight is followed by a gradual fall in the altitude gained until a reaction to the deeper ground shadows or other conditions causes them to emit another flash accompanied by a vertical ascension.

Preliminary tests made with a powerful 3-cell battery, spot, flash light capable of throwing a concentrated beam near 500 feet, have given some results of interest. In a number of tests, carefully directing the beam vertically down upon the hovering firefly, caused it to cease its upward propulsions and actually to descend and finally alight upon the grass. At other times the hovering insect made very weak efforts to flash and propel itself upward, and if it succeeded, it seemed to do so in response to a very weak impulse. When the beam of light was directed against the sluggish insect vertically from below, the reaction was usually sharp and sudden, the insect being oftentimes driven precipitately high into the air and away in an oblique trend as the beam struck it more or less from an angle. Oftentimes when the insect had assumed the sluggishly hovering position and the beam struck full upon it from the side, the reaction was as sharp as if the insect were in a state of fright, and it might fly away precipitately as if to escape. In a few instances the beam of light has caused the insect to fly toward its source, but this has occurred only when the flash light was held very close to the insect, apparently causing it to appear as a localized point of light.

There are some features of this distinctive early twilight behavior of the fireflies that are rather puzzling. Following a flash with its incident upward propulsion, the insect in its subsequent hovering and downward drift, somehow appears keenly aware of a near approach to herbage or leafage, to a highly sensitive degree. Normally it rarely alights, but at the critical instant, just prior to contact, emits a flash and makes a sudden sharp trajectory flight upward. Again and again, this behavior is repeated until the dusk has deepened.

I have made several tests centering around this behavior, which, although more or less preliminary, indicate a proximity sense of some sort. In one test I cut a long slender green branch from a tree, and very carefully brought it beneath the descending insect. The creature, as before, checked its descent when almost in contact with the green leafage and shot upward on its flash. Before it could descend to its former level I very carefully raised the branch above this level so that the descent of the insect would be blocked at a higher point. The flash and upward propulsion occurred as before, bringing the insect ever higher until it had mounted far beyond my reach. These tests indicated that little could be definitely learned by using a green branch. I now obtained a good-sized piece of fine chicken wire with a two-inch mesh and folded it once to decrease the size of the interspaces. A piece of this, about two feet square, was fastened horizontally to the end of a long, slender handle. It is evident that this equipment would more nearly assume the true air temperature than cool, transpiring green leafage. On

the whole, the insects reacted differently to this wire when placed beneath them, for sometimes they came in contact with it in their descents, or even passed through its mesh spaces as if quite unaware of its presence. Strangely enough when held above the insect, its upward propulsion often caused it to bump into the wire, a behavior which was also shown when the green branch was held above it. This would indicate that the insects are more positively sensitive to objects below them than to objects above them.

In other tests a piece of two-inch mesh chicken-wire about four feet wide and ten feet long was fastened in a horizontal position about a foot above the herbage, in an open area frequented by them each evening. As the insects arose following sunset, their sallies of ascent and descent were noted within the area embraced by the wire. This test indicated that their reactions to the thin strands of wire were not as positive as their reactions to green herbage. While it would seem that a temperature factor is involved here, the matter can not be considered definitely settled without further intensive study. As the problem at present stands, my own observations would indicate that the distinctive, seemingly aimless hovering flight of the fireflies with alternations of upward propulsion and slow downward driftings, as they first arise from the herbage, is a response to decreasing light intensities to which they are slowly adjusting themselves until the critical levels have been passed, and their true night has begun. During this period of adjustment it would appear that the checking of the descent, with a flash and sudden upward propulsion just as the herbage is nearly reached, is dependent upon some nicety of sense perception which may prove to be a matter of fine temperature discrimination. To say the least the behaviors probably fall into some definite reaction-category, quite independent of any specific psychic manifestations on the part of the insect.

One point here is still not clear to my mind, viz: What is the reason for the upward propulsion following the flash, which is abandoned for direct horizontal flight later in the evening? Why at this transition period are the wing movements of such an order that the vertical component alone is favored? Is it due to an excessive, unbalanced expenditure of energy thrown into the wing-strokes? There is something weirdly mechanical in it all, simulating the longer, more sustained vertical drive stimulated by a flash-light beam directed upward upon the insect from below. It would almost appear that the insect is driven upward by its own light, and I am inclined to believe that if its own light were not momentary, this upward propulsion would be more sustained. In other words the momentary flash affords an efficient stimulus to a momentary expenditure of

violent energy, which is of assistance in enabling the insects to gain altitude for subsequent continuous flight when the evening twilight has fallen to certain favorable levels.

In addition to these peculiarities of photoperiodism in the behavior of the fireflies, a study was at the same time made of those conditions responsible for the first appearance of the insects each day. These observations are presented in table I together with other data bearing on conditions at the time. In figure 1, graphs have been constructed showing the relation of the time of first appearance at sunset, to temperature, relative humidity and the time of sunset.

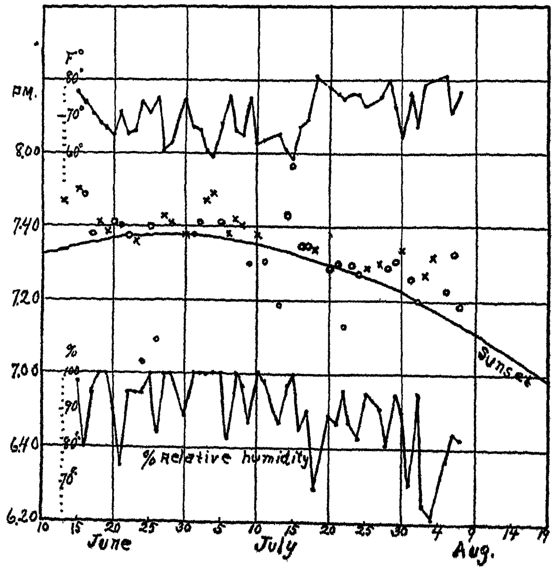


Fig. 1. Time of arising of fireflies from the grass in the open at Lyon Park, Va., 1930, in relation to temperature and relative humidity at the time. Crosses represent clear skies; circles represent hazy or partly cloudy skies; dots represent very cloudy or stormy skies.

On the whole, mean changes in the time of sunset have been rather closely followed both by the fireflies arising in the open, and by those arising earlier in heavily shaded situations. It would appear that the fireflies are quite sensitive in their perceptions of the changes of light intensity taking place as the sunset becomes progressively earlier each day after June.

TABLE I.

Time of appearance of the first fireflies in the evening from an open grass and weed plot at Lyon Park, Virginia, and from the heavy shade of a hedge and trees nearby.

Date	*Skies*	*First fireflies arise in open*	*First fireflies arise in shade*	*Wind velocity per minute*	*Ground conditions*	*Sunset E. S. T.*	*Air temperature at grass level. F.°*	*Wet bulb at grass level*	*Relative humidity*	*Appearance before or after sunset in open*
June 13	clear	7.45 P. M.	....	none	very dry	7.34	....	....	....	13 minutes after
15	clear	7.50 P. M.	....	none	very dry	7.35	77°	76.5°	98%	15 minutes after
16	partly cloudy	7.49 P. M.	....	2–3 ft.	very dry	7.35	74°	69.5°	80%	14 minutes after
17	very cloudy, rain	7.38 P. M.	....	none	rain soaked; raining	7.36	71°	70°	95%	2 minutes after
18	clear	7.41 P. M.	....	none	heavy dew	7.36	68°	68°	100%	5 minutes after
19	clear; black clouds, west	7.39 P. M.	7.35	none	heavy dew grass wet at 7 30	7.37	67°	67°	100%	2 minutes after
20	slight haze	7.41 P. M.	7.38	none	....	7.37	65°	63°	90%	4 minutes after
21	very hazy and clouds Southwest and North	7.40 P. M.	7.36	slight air drift only	....	7.37	71°	65.5°	75%	3 minutes after
22	slight haze	7.38 P. M.	7.36	slight air drift only	....	7.37	65°	64°	95%	1 minute after
23	clear	7.46 P. M.	....	slight air drift only	....	7.37	66°	65°	95%	9 minutes after
24	very cloudy	7.03 P. M.	....	slight air drift only	sudden thunder-storm, very dark at 7.00	7.37	74°	73°	95%	34 minutes before
25	slight haze	7.40 P. M.	7.32	slight air drift only	....	7.38	71.5°	71.5°	100%	2 minutes after
26	very cloudy, thunder-storms in S. W. and N.	7.09 P. M.	6.45	slight air drift only	very dark with heavy clouds	7.38	71.5°	71 5°	84%	29 minutes before
27	clear, some brilliant reflecting clouds, west	7.43 P. M.	7.35	slight air drift only	....	7.38	60°	60°	100%	5 minutes after
28	clear, some brilliant reflecting clouds west	7.41 P. M.	....	slight air drift	....	7.38	62.5°	62.5°	100%	3 minutes after
30	clear, bright crescent moon	7.38 P. M.	....	slight air drift	....	7.38	72.5°	72.5°	89%	at sunset
July 1	very cloudy, clear areas west	7.38 P. M.	7.35	none	rain soaked, heavy dew	7.38	66.75°	66.75°	100%	at sunset
2	heavy detached clouds	7.41 P. M.	7.32	none	rain soaked, heavy dew	7.38	66°	66°	100%	3 minutes after
3	clear, half moon	7.47 P. M.	7.35	none	rainsoaked, heavy dew	7.37	60°	60°	100%	10 minutes after

Date	*Skies*	*First fireflies arise in open*	*First fireflies arise in shade*	*Wind velocity per minute*	*Ground conditions*	*Sunset E. S. T.*	*Air temperature at grass level F.°*	*Wet bulb at grass level*	*Relative humidity*	*Appearance before or after sunset in open*
July 4	clear, half moon	7.49 P. M.	7.42	none	rain soaked, heavy dew	7.37	59 25°	59.25°	100%	12 minutes after
5	hazy, bright moon	7.41 P. M.	7.37	none	rain soaked, heavy dew	7.37	68°	68°	100%	4 minutes after
6	detached clouds	7.38 P. M.	7.23; again 7.34	none	....	7.37	75.5°	71.5°	82%	1 minute after
7	clear, brilliant moon	7.42 P. M.	7.32	none	heavy dew	7.37	66°	66°	100%	5 minutes after
8	slight haze; brilliant moon	7.40 P. M.	7.34	none	....	7.36	65°	64.5°	97%	4 minutes after
9	very cloudy to zenith	7.30 P. M.	7.30	none	no dew	7.36	75.5°	72.5°	86.5%	6 minutes before
10	slight haze	7.38 P. M.	7.19	none	heavy dew	7.36	62 5°	62.5°	100%	2 minutes after
11	very hazy; dusk early	7.31 P. M.	7.28	none	no dew	7 35	73.5°	71°	88.5%	4 minutes before
13	very dark, cloudy	7.19 P. M.	....	none	no dew	7 35	75 5°	72.5°	86.5%	15 minutes before
14	detached clouds	7.43 P. M.	7 34	none	heavy dew	7.34	61°	60 5°	97%	9 minutes after
15	very hazy	7.57 P. M.	....	none	no dew	7 33	58°	58°	100%	27 minutes after
16	very hazy	7.35 P. M.	7.34	none	no dew	7.33	67°	64°	85%	2 minutes after
17	very hazy	7.35 P. M.	7.26	none	no dew	7.32	69°	67°	90%	3 minutes after
18	clear	7.34 P. M.	....	7–8 ft.	no dew	7.31	81°	73°	68.5%	3 minutes after
20	very hazy	7.29 P. M.	7.20	none	no dew	7.31	78°	75.5°	89%	2 minutes before
21	very hazy with detached clouds	7.30 P. M.	7.13	none	no dew	7.29	76.5°	73.5°	87%	1 minute after
22	very dark, cloudy	7.13 P. M.	6.51	slight	rain soaked	7.29	75°	74°	96%	16 minutes befere
23	detached clouds	7.30 P. M.	7.25	none	no dew	7.28	76.5°	73.5°	87%	2 minutes after
24	some detached clouds	7.27 P. M.	7.16	none	no dew	7.28	76.5°	72.5°	82 5%	1 minute before
25	very slight haze	7.29 P. M.	7.29	none	no dew	7.27	73°	72°	95%	2 minutes after
27	very slight haze	7.30 P. M.	7.29	slight	no dew	7.25	75°	73°	91%	5 minutes after
28	slight haze	7.29 P. M.	7.15	slight	no dew	7.24	79.5°	75°	81%	5 minutes after
29	slight haze	7.31 P. M.	7.23	none	rain wet	7.24	72.5°	71 5°	95%	6 minutes after
30	clear, bright moon	7.34 P. M.	7.26	none	no dew	7 23	64 5°	62.5°	90%	11 minutes after
31	hazy; detached clouds	7.26 P. M.	....	slight	no dew	7.22	76°	69°	70%	4 minutes after
Aug. 1	very hazy	7.20 P. M.	7.18	none	no dew	7.20	67 5°	66 5°	95%	at sunset
2	clear, bright moon	7.27 P. M.	7.23	slight	no dew	7.19	79°	70°	64%	8 minutes after
3	clear, bright moon	7.32 P. M.	7.30	slight	no dew	7 18	80°	70°	61%	14 minutes after
5	hazy	7.23 P. M.	7.22	none	no dew	7.17	81°	75°	77.5%	6 minutes after
6	hazy detached clouds	7.33 P. M.	....	none	no dew	7.16	71 5°	68°	84%	17 minutes after
7	very hazy and cloudy	7.19 P. M.	....	none	no dew	7.15	77°	73°	83%	4 minutes after

TABLE II

The following relations together with changes in the time of sunset have been determined from the data in table I.

For fireflies arising in the open, unshaded area.

Mean time of sunset June 13 to June 30, inclusive=7.36; Mean time of first appearance in same period=7.37
Mean time of sunset July 1 to July 10, inclusive=7.36; Mean time of first appearance in same period=7.40
Difference= 0; Difference=3 minutes
*Divide by 19 days giving mean change per day= 0; Divide by 19 days giving mean change per day=.157 minutes
Mean time of sunset July 11 to July 20, inclusive=7.33; Mean time of first appearance in same period=7.35
Mean time of sunset July 21 to Aug. 7, inclusive=7.22; Mean time of first appearance in same period=7.27
Difference=11 minutes; Difference=8 minutes
*Divide by 16 days giving mean change per day= .7; Divide by 16 days giving mean change per day=.5 minutes

For fireflies arising in the shade of a rose hedge and beneath the heavy shade of trees.

Mean time of sunset June 13 to June 30, inclusive=7.37; Mean time of first appearance in same period=7.36
Mean time of sunset July 1 to July 10, inclusive=7.37; Mean time of first appearance in same period=7.32
Difference= 0; Difference=4 minutes
*Divide by 14 days giving mean change per day= 0; Divide by 14 days giving mean change per day=.285 minutes
Mean time of sunset July 11 to July 20, inclusive=7.31; Mean time of first appearance in same period=7.28
Mean time of sunset July 21 to Aug. 7, inclusive=7.22; Mean time of first appearance in same period=7.20
Difference=8 minutes; Difference=8 minutes
*Divide by 11 days giving mean change per day = .7; Divide by 11 days giving mean change per day=.7 minutes

*The mean change per day has been found by dividing the entire mean change in sunrise taking place between the first and second periods of time by the number of days elapsing to produce these mean changes.

Mean time before or after sunset when the fireflies appeared from the grass and herbage, both in the open and in shaded situations.

June 13 to June 30, inclusive, in open	= .937	minutes after sunset
June 13 to June 30, inclusive, in shade	=9.2	minutes before sunset
July 1 to July 10, inclusive, in open	=3.5	minutes after sunset
July 1 to July 10, inclusive, in shade	=5.0	minutes before sunset
July 11 to July 20, inclusive, in open	=6.6	minutes after sunset
July 11 to July 20, inclusive, in shade	=4.6	minutes before sunset
July 21 to Aug. 7, inclusive, in open	=4.2	minutes after sunset
July 21 to Aug 7, inclusive, in shade	=3.9	minutes before sunset

Mean time, before or after sunset of first appearance of fireflies in open and in shaded situation, for clear, cloudless, hazy or partly cloudy, and cloudy or stormy evenings.

Time of arising in open.

Clear, cloudless evenings, June 13 to Aug. 7, inclusive=8.7 minutes after sunset.

Hazy or partly cloudy (detached clouds) June 13 to Aug. 7, inclusive = 3.6 minutes after sunset.

Very cloudy, dark evenings or rainy, June 13 to Aug. 7, inclusive = 11.2 minutes before sunset.

Time of arising in shaded situations.

Clear, cloudless evenings June 13 to Aug. 7, inclusive=2.8 minutes before sunset.

Hazy or partly cloudy (detached clouds) June 13 to Aug. 7, inclusive = 7.0 minutes before sunset.

Very cloudy, or rainy evenings June 13 to Aug. 7, inclusive = 32.3 minutes before sunset.

The time of appearance on clear, hazy and partly cloudy, and dark cloudy evenings is additional confirmation that the fireflies appreciate rather nice gradations in light intensity more or less comparable to the visual discriminations of birds and humans.

As indicated in the graphs of figure 1, there is some evidence of a seeming positive correlation with conditions of humidity as well as with sunset. However, the relations of the first evening appearance of the fireflies to shade and to differences in the clearness of the skies, and the fact that some of the earliest appearances have occurred when the relative humidities have been very high, would indicate that the general trend of the curve of the relative humidity has been only accidentally associated with that of the sunset curve. In other words the curve of humidity is a result of an abnormally hot and dry season which prevailed in July as the evening temperatures steadily mounted until late in the month.

The more direct relation of the fireflies' first evening appearance appears to be with the time of sunset, the time of appearance on clear cloudless evenings following soon after the setting of the sun. It would appear that their movements in the field are activated by a more or less specific level of light intensity operating through the visual sense, comparable to the birds that are stimulated to sing their dawn and twilight songs at certain specific levels.

TWO NEW PERUVIAN MICROLEPIDOPTERA OF ECONOMIC IMPORTANCE (GELECHIIDAE AND OECOPHORIDAE).

By August Busck, *U. S. Bureau of Entomology.*

Gnorimoschema tuberosella, new species. (Pl. 1, Figs. 3, 5.)

Second joint of labial palpi whitish ochreous, sprinkled with fuscous; terminal joint ochreous with a broad incomplete black annulation at base and an even broader, likewise incomplete, black annulation just before the tip; extreme apex yellow. Maxillary palpi short but plainly discernible, appressed to base of the spiraled tongue. Antennae ochreous, with narrow black annulation, basal joint long, shaded with dark fuscous. Face iridescent, ochreous white; head and thorax light ochreous, sprinkled with dark fuscous. Fore wing whitish ochreous overlaid with darker ochreous and fuscous scales, especially on dorsal half; a broad, dark brownish-black, oblique streak from basal fourth of costa reaches beyond the cell; it is more strongly emphasized on the cell in an elongate ovate spot of deeper black and fades gradually out in the fuscous scaling on upper half of the wing to apical fourth; at apical fourth is an ill-defined, unmottled costal spot of the ground color; a similar dorsal spot somewhat nearer apex; at the end of the cell a short black streak; a similar black streak before apex is preceded and surrounded by brown scales; cilia light ochreous, dotted with dark fuscous scales. Hind wings broader than fore wings, dark fuscous with ochreous fuscous cilia. Venation typical; fore wing with 12 veins; 1 *b* furcate at base, 1 *c* present on basal half, fading out toward the edge; 2, 3, and 4 equidistant; 5 slightly approximate to 4; 6 free; 7 and 8 stalked to costa; 9 free; 11 from before the middle of cell. Hind wing with 8 veins; 3 and 4 connate; 5 distant but bent toward 4 at base; 6 and 7 parallel; no costal tuft in either sex. Abdomen light ochreous sparsely sprinkled with fuscous; dorsum of first, second, and third joints with the usual velvety, short, yellow scaling common in the genus; first joint sprinkled with black scales. Legs silvery ochreous; tibiae strongly mottled with black exteriorly; front and middle tarsi with black annulations; posterior tibia with long hairs on upper side.

Male genitalia (Pl. 1, Fig. 5) typical of genus; tegumen elongate, with two short, strongly chitinized lateral processes; vinculum, with long, slender anterior process, is fused with the anellus, which is very large and broad and terminates in three processes, a central, very long, strongly chitinized, spike and two lateral shorter, less chitinized, pointed lobes; the aedoeagus is very long, slightly bulbous at base, deeply cleft at apex into two nearly equal forks with the penis opening laterally on the larger fork. Eighth segment strongly developed into a dorsal and a ventral cover for the genitalia when at rest.

Female genitalia (Pl. 1, Fig. 3) with genital plate large and fused with the penultimate joint and its supporting internal rods; ductus bursa a strongly chitinized tube from ostium to the end of the rods, there broadening out into a small, soft, heart-shaped bulb, with a short chitinized center and continued unchitinized to the bursa, which contains a short, stout, spinelike signum.

Alar expanse 15–17 mm.

Type.—U. S. National Museum No. 43309.
Type locality.—Lima, Peru.
Foodplant.—*Solanum tuberosum.*

Received from Dr. Johannes Wille, who reports that the larvae feed not only in the tubers but also in the stalks of cultivated potatoes. The species was previously received from Dr. C. H. T. Townsend, who reported it injurious to potato at Callao, Peru, in 1927.

The species is close to *Gnorimoschema* (*Phthorimaea*) *aquilina* Meyrick, also described from Peru, but is smaller and differs in details of ornamentation as well as in genitalia. This species was described under the generic name *Phthorimaea* Meyrick, but was subsequently placed in *Gnorimoschema* by him in the text of his Revision of the *Gelechiidae*, though his colored figure is named *Phthorimaea*. *Phthorimaea* was originally established on the costal hairtuft in the hind wings of the male of the genotype *P. operculella*, but this character is not found in most of the species now included in the genus, and Meyrick has attempted to differentiate between this genus and *Gnorimoschema* Busck on slight differences in the length and scaling of the terminal joint of the labial palpi, differences, however, which do not hold, but appear in gradual modification in all the species included in both genera. In all important characters of the oral parts, the venation, and the genitalia, *opercullela* and most of the species placed with it conform with *Gnorimoschema*, and the writer, therefore, reluctantly abandons the well-known name *Phthorimaea* for the other "well-known form" *Gnorimoschema* Busck, which has two years' priority. A few of the species placed in *Phthorimaea*, like *glochinella* Zeller and *lycopersicella* Busck, differ from the types and the bulk of the species in possessing a strong hook-like uncus, instead of the normal hoodlike uncus characteristic of the genus, and these may eventually require a new generic name. (See Busck, Proc. Haw. Ent. Soc., vol. 7, p. 173, 1928.)

Eucleodora cocae, new species. (Pl. 1, Figs. 1, 2, 4, and 6.)

Labial palpi long, recurved; second joint thickened, with smoothly appressed scales, slightly serrated below and at apex; light ochreous brown on inner side, darker brown exteriorly, with the scales white tipped, so as to form an ill-defined transverse striation; terminal joint as long as second, thickened, with long loose scales on posterior edge, smooth anteriorly (Pl. 1, Fig. 2), reddish brown with posterior tuft dark fuscous, extreme apex acute, light whitish ochreous. Antennae slightly longer than fore wing, serrate, especially toward the tip, brown with light ochreous underside; no pecten on basal joint. Face smooth, light ochreous; head brown with spreading side tufts extending over the basal joint of the antennae. Thorax light brown, smooth. Fore wing elongate, costa slightly arched; apex falcate, termen deeply and abruptly ex-

cavated below apex, thence broadly rounded at tornus; dorsum straight; on costal base a light ochreous patch extended in an oblique streak to middle of dorsum; dorsal base dark brown; at costal third a broad, trapezoidal, bluish patch terminated on the middle of costa by two outwardly oblique, light yellow streaks; these reach nearly to the end of the cell and are separated by a narrow bluish metallic streak and edged exteriorly with white scales on the costa; beyond these streaks the wing is rich brown with a blackish brown, longitudinal, central line before apex and mottled with light ochreous; below the trapezoidal costal patch is an elongate, oval, deep brown spot; cilia brown, with a yellow tuft below the falcate apex, and with base yellow edged by a perpendicular black line. Hind wing with costa and dorsum nearly straight, termen obliquely rounded, apex blunt; dark lead-colored; cilia dark fuscous, light ochreous at the tip of the wing; in male with a strong expansible, light ochreous hair-pencil from base of costa, reaching beyond the middle of costa.

Venation typical (Pl. 1, Fig. 4); fore wing with 12 veins, 1 *b* single at base, the upper fork being obsolete; 1 *c* present at outer half to edge of wing; 2 from just before the end of the cell; 3 and 4 closely approximate from the end of the cell; 5 and 6 parallel, widely separated; 7 and 8 stalked to costa; 11 from middle of cell.

Hind wing with 8 veins; 3 and 4 shortstalked; 5, 6, and 7 parallel; 5 nearer to 6 than to 4 and 6 nearer to 5 than to 7.

Abdomen dark fuscous above, with light ochreous underside. Legs whitish ochreous on their inner sides; anterior tarsi thickened exteriorly, with light brown scales; middle and hind tarsi dark fuscous exteriorly with narrow bars of white; tarsi dark fuscous, whitish ochreous annulations.

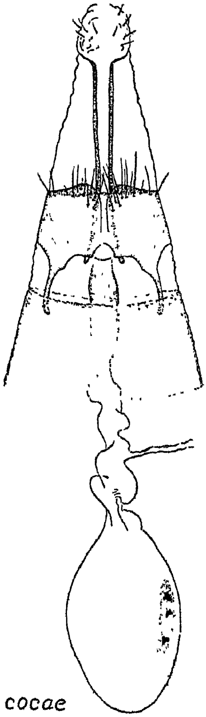
Male genitalia (Pl. 1, Fig. 6) with tegumen rectangular, ending in two shallow soft lobes hardly differentiated enough to be termed uncus; socii absent; gnathos divided into two shortstalked, elongate, egg-shaped tassels from the corners of the tegumen, curiously ornamented with large rough scales, arranged in a close spiral; it may be argued that these organs are the socii and not the gnathos, but I judge that they correspond to the similar scaled, unpaired, knobbed tip of the gnathos typical of many Oecophorids, and which in many forms tend to become divided; harpes narrow and divided on their outer half into two short, hairy lateral lobes; aedoeagus straight, bulky, with very large oval opening for the penis, extending more than half the length of the whole aedoeagus.

Female genitalia (Pl. 1, Fig. 1) with ostium simple; ductus rather long, spiraled on itself in two close loops and with a short chitinized ring near ostium; bursa elongate ovate; signum an elongate oval plate with two (or three?) short but heavy double spines.

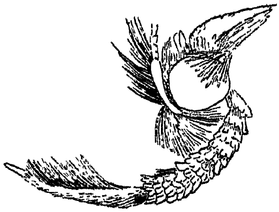
Alar expanse.—11–12.5 mm.

Type.—U. S. National Museum No. 43310.
Type locality.—Otuzco, Peru.
Foodplant.—*Erytroxylon coca* (Johannes Wille).

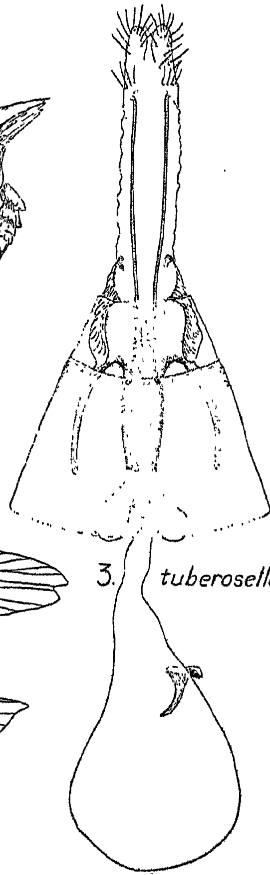
Doctor Wille reports that the larvae feed on the leaves of the coca plant and that the damage caused by them amounts to about 60 per cent of the harvest in the height of the season and to about 20 per cent in the winter months.



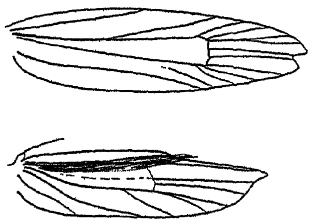
1. cocae



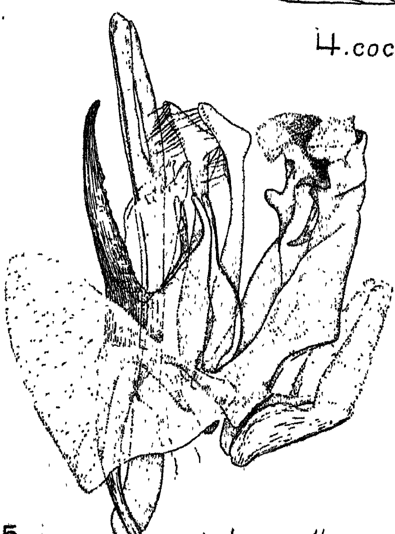
2. cocae



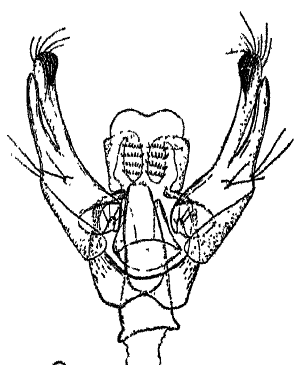
3. tuberosella



4. cocae



5. tuberosella



6. cocae

Meyrick has erected the genus *Psittacastis* for the American representatives of the African genus *Eucleodora* Walsingham, on the smooth terminal joint of the labial palpi (versus the posteriorly tufted third joints of *Eucleodora*). The genotypes of both *Psitticastis* and its synonym, *Necedes* Walsingham, have truly smooth terminal labial joints at once distinguishable from those of the present species, which perforce must go in *Eucleodora*. The several described and undescribed species of this immediate group, characterized by the falcate fore wing with the striking involved color-ornamentation, are very similar in all the other characters and especially in the genitalia, though amply differentiated specifically, both in genitalia and in details of coloration of wings, palpi, and legs.

EXPLANATION OF PLATE

Drawings made by Mrs. Eleanor A. Carlin under the direction of the author.

1. *Eucleodora cocae* Busck. Female genitalia.
2. *Eucleodora cocae* Busck. Head and labial palpi.
3. *Gnorimoschema tuberosella* Busck. Female genitalia.
4. *Eucleodora cocae* Busck. Wing venation.
5. *Gnorimoschema tuberosella* Busck. Male genitalia.
6. *Eucleodora cocae* Busck. Male genitalia

THOMAS SAY, EARLY AMERICAN NATURALIST, BY HARRY B. WEISS AND GRACE M. ZIEGLER. Charles C. Thomas, Springfield, Ill., 260 pages, 27 illustrations.

A delightful, authentic biography; entirely uncolored by personal opinion.

Here the reader may see the personality of Thomas Say emerge from the dust and cobwebs of a century, as the gentle, amiable, steadfast naturalist that he was. No dashing lusty giant such as Audubon was he. Rather poorly endowed with physical stamina, through sheer love of his calling and the exercise of a dogged continuity of purpose throughout his short lifetime of 47 years, he accomplished more than do many stronger men who attain to twice that span.

Surmounting the respect which his ability as a naturalist evoked from his intimates, there is in plain view the fact that he possessed their warmest affection and confidence in a degree which is the infallible index to an unselfish soul. Say's letters breathe consistently a spirit of honesty and mutual aid and reveal, at the age of 29, a store of wisdom and caution which is most admirable in the descriptive naturalist. Evidently realizing that he faced a vast and but slightly worked field for descriptive writing, he deliberately refused to run amok in it, as is shown by the following excerpt from a letter addressed to his friend Melshimer:

"It is certainly of the first importance to a naturalist to know what has been done by others in his particular science in order that his researches may be directed to proper objects that he may not do over again what has been better done by his predecessors—I am determined to be as cautious as possible in this respect."

That he acted in accordance with this resolve is obvious from the permanence of his work. Were one to interpret too literally the "Foreword" to this book he might easily gain the impression that here, at last, was one naturalist who was fortunate in all things. At the end of the story, however, the reader lays the book aside with the feeling that Thomas Say trod the boards of this "earthly stage" amid the trials and disappointments common to a vast majority of mankind, from failure in his first business venture and the loss of all the notes of his first extensive exploration, to recurrent and increasing physical illness and early death. The truth appears to be that with the aid of a few good friends, not the least of whom was a lovely and clever wife, but largely in spite of "hell and high water," he managed to live the life of a naturalist and do the work that his heart craved, to the glorification of manhood and the advancement of Natural Science in America.

This book is of chief importance to those interested in the history of the natural sciences in America but it would grace the shelves of any man's library. —*W. R. Walton.*

THE MALE OF MESOVELOIDEA WILLIAMSI HUNGERFORD (HEMIPTERA: HETEROPTERA).

By DR. T. JACZEWSKI, *Polish Museum of Zoology, Warsaw, Poland.*

Prof. H. B. Hungerford has described recently (Bull. Brooklyn Ent. Soc., XXIV, 1929, pp. 288–291) a new genus and species of semi-aquatic Hemiptera, *Mesoveloidea williamsi* Hung. which should be referred with all probability to the family *Mesoveliidae*. The original description is based upon two female specimens from Mera in Ecuador.

In material of *Mesoveliidae* received for study from the U. S. National Museum, I was glad to discover three male specimens which belong beyond any doubt to the same species. I take this opportunity to give in the following, some supplementary details concerning the morphology of the males of this interesting waterbug.

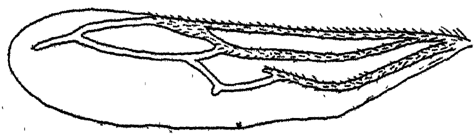


Fig. 1

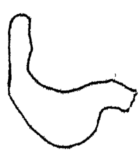


Fig. 2

Color and general structural characters strictly as described for females by Prof. Hungerford. On the membrane of the hemelytra the veins form a longitudinal outer cell (Fig. 1) which is not found in *Mesovelia* Mulsant and Rey. The male genital segments show the same type of structure as in *Mesovelia*. The eighth abdominal segment is subcylindric in shape, its posterior margin being rounded dorsally and quadrangularly emarginated ventrally. The terminal abdominal segments are covered with fine hairs, but no tufts or fringes of modified hairs or spines are present; the postero-exterior angles of the seventh segment, as well as the caudal end of the eighth segment dorsally, bear longer and more bristle-like hairs. Ninth segment basket-like as in *Mesovelia*. Parameres hook-like, blunt at the end, rather wide at their curvature (Fig. 2). Penis in state of non-extension about equal in length with the parameres, slightly curved. Anal cone as in *Mesovelia*.

Length 2, 5–2, 75 mm.

Three macropterous males, Cachali, Ecuador, coll. Rosenberg (U. S. N. M.).

EXPLANATION OF FIGURES

Fig. 1. *Mesoveloidea williamsi* Hung., ♂. Hemelytron, x33.
Fig. 2. *Mesoveloidea williamsi* Hung., ♂. Paramere, x185.

FURTHER NOTES ON THE AMERICAN SPECIES OF MESOVELIA MULSANT AND REY.

Just a few days after the publication of my last paper on the American species of *Mesovelia*[1] a copy of Dr. Horvath's excellent Catalogue of the Mesoveliidae[2] came to my hands. As, unfortunately, some incongruency will be noticed in these two publications I venture to take this opportunity to make some additional remarks on the subject.

In my paper I have treated the American *Mesovelia mulsanti* B. White as a single, although variable species with the following four subspecies: the typical *M. m. mulsanti* B. White from the Amazonas (males unknown hitherto), the South American *M. m. meridionalis* Jacz., the North American *M. m. bisignata* Uhl. and the Central American and Caribbean *M. m. caraiba* Jacz.

Dr. Horvath lists in his Catalogue *M. mulsanti* B. White and *M. bisignata* Uhl. as two distinct species, the other two subspecies having not yet been established when he was writing his Catalogue. Personally I do not feel that the South and North American specimens of *M. mulsanti* B. White should be looked upon as clearly distinct specifically, the morphological differences between them being rather insignificant and, as I am inclined to think, of, at most, subspecific rank. But this is more a matter of opinion in ascribing greater or smaller

[1]Notes on the American Species of the Genus *Mesovelia* Muls. Ann. Mus. Zool. Pol., Warszawa, IX, 1930, No. 1.

[2]General Catalogue of the Hemiptera, Fasc. II. Northampton, Mass., 1929.

importance to certain differences which can be found between closely allied forms.

The chief correction which I would like to make in connection with Dr. Horvath's Catalogue concerns another point. In giving the distribution of the two species, Dr. Horvath lists all Central American localities under *M. mulsanti* B. White, leaving with *M. bisignata* Uhl. only the localities lying within the political limits of the United States. From the results of my studies it can be seen, however, that the Central American and Caribbean subspecies *M. m. caraiba* Jacz. seems to be particularly closely allied with the North American *M. m. bisignata* Uhl., being linked with it even by transitory forms. If we consider, therefore, *M. bisignata* Uhl. and *M. mulsanti* B. White as two distinct species we should refer *M. m. caraiba* Jacz. doubtlessly to the former and not to the latter. In consequence we should cancel in Dr. Horvath's Catalogue, from the distribution of *M. mulsanti* B. White, the localities: Panama, Guatemala, Cuba, S. Domingo, Guadeloupe, Grenada, St. Vincent and Mexico, and transfer them under his *M. bisignata* Uhl.

MINUTES OF THE 426TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON.

The 426th regular meeting of the Entomological Society of Washington was held at 8 p. m., Thursday, February 5, in Room 43 of the new building of the National Museum. Dr. A. C. Baker, President, presided. There were present 34 members and 38 visitors. The minutes of the 425th meeting were read and approved. Mrs. Nancy Harper Wheeler, of the Bureau of Entomology, and Prof. Paul N. Musgrave, Principal of the Junior High School, Fairmont, W. Va., were admitted to membership. The corersponding Secretary-Treasurer announced that a new program committee had been appointed, consisting of S. B. Fracker, B. A. Porter, and R. A. Cushman.

The first communication on the regular program was given by E. J. Newcomer, of the Bureau of Entomology, and was entitled "Fruit Insect Problems in the Northwest." The most important fruit insects economically in the irrigated regions of Washington are the codling moth, San Jose Scale, fruit-tree aphids, and red spiders. The tarnished plant bug at times causes severe injury. The most interesting minor pests are certain apple mites which seem to be distinct from *Eriophyes* pyri (Pgst.), a rust mite (*Phyllocoptes schlechtendali* Nal.), a tree hopper (*Heliria rubidella* Ball) which differs from other tree hoppers in that the nymphal stages live on the trees, and an œcophorid moth (*Schiffermuelleria coloradella* Wlsm.) the larvae of which live on the dying bark in the cankers of *Gloeosporium perennans* Zell. & Childs. This paper was discussed by Howard, Graf, and Rohwer.

The second communication on the program was presented by Austin H. Clark, of the National Museum, and was entitled "Selling Entomology."

This will be published in full in an early number of "Scientific Monthly." This paper was discussed by Howard and Baker.

The next communication on the program was presented by C. F. Doucette, of the Bureau of Entomology, and was entitled "Narcissus Production Methods in the Puget Sound Area with Special Reference to Insect Control." Motion pictures were shown of certain phases of narcissus bulb culture on the Pacific Coast, largely the plants as they appear in the fields, with some views of digging and other cultural operations carried on by machine. Brief discussion of the relation of the bulb flies to the cultures was made.

Pictures were also shown of Mt. Rainier, and attention called to it as a comparatively untouched area as far as insect collecting is concerned, and an area of exceptional ecological promise with its great variations in zones within short distances. This paper was discussed by Baker, Graf, Howard, and Gahan.

Remarks were made by Dr. David Griffiths, in charge of Bulb Culture Investigations of the Bureau of Plant Industry, who discussed bulb work in the Puget Sound Region with particular reference to daffodils, narcissus, tulip, and lily. He stressed the growing importance of this industry; one company in Oregon alone having shipped 7,000,000 lily bulbs the past season to the British Isles, Egypt and other destinations. According to the census figures the annual average is 190,000,000 bulbs; although the past season, being a poor one because of too much cold weather, the total was cut down to 160,000,000 bulbs. He also emphasized the high quality of the product as being equal to the best produced in other countries. Doctor Neil Howard, of the Bureau of Entomology, on invitation also discussed briefly the past season's work with the Mexican bean beetle and gave some figures on rearing and liberation of a tachinid parasite which gives excellent promise. The extensive drought of the past season greatly depleted the bean beetle population; although the pest is far from being exterminated.

The meeting adjourned at 9:45 p. m.

J. S. WADE,
Recording Secretary.

Actual date of publication, March 21, 1931.

PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 33 APRIL, 1931 No. 4

NOTES ON HIPPELATES (DIPTERA: CHLOROPIDAE), WITH A NEW BRAZILIAN SPECIES.

By J. M. ALDRICH, *U. S. National Museum.*

The genus was established by Loew in Berliner Ent. Zeitschrift, vol. 7, 1863, p. 38 (Centuries, part. 3, No. 69). He described two species, *nobilis* and *plebejus*, and strangely overlooked the hind tibial spur in his *Oscinis pallipes* (page 39), and *Oscinis flaviceps* (page 40), which also belong to *Hippelates*, as I found in examining the types, at the Museum of Comparative Zoology, in 1915. Coquillett designated *plebejus* as type in Proceedings U. S. Nat. Mus., vol. 37, 1910, p. 552; while Enderlein designated *nobilis* as type, in Sitzungsberichte Ges. Naturforsch. Freunde, 1911, p. 191, probably not having seen Coquillett's paper.

Malloch published a thorough revision of the North American species in Proceedings U. S. Nat. Mus., vol. 46, 1913, pp. 239–266, with two plates. As he had not seen Loew's types, he made some mistakes in identifying the Loew species, which I corrected in these proceedings, vol. 31, 1929, p. 35.

A new paper entitled "Die neotropischen Chloropiden," by Dr. Oswald Duda has lately been sent to me by the author, with the explanation that it is a mere fragment, hardly one-eighth of his manuscript, of which he was unable to get the remainder published. It was published in Folia Zoologia et Hydrobiologia, vol. 2, September, 1930, pp. 46–128. The author attempted a revolutionary treatment of the family, but the part printed consists only of keys and is almost impossible to follow. I refrain from further discussion of it at present.

Mr. C. H. Curran has published four species of *Hippelates* in American Museum Novitates, No. 220, 1926, pages 4 and 5; these are all from the West Indies.

It is not proposed to revise the genus herein, but merely to give some notes along with the description of the new species.

The standing of *Hippelates* has been questioned in recent years. Kertesz examined the type of *Cadrema lonchopteroides* Walker, described from Celebes in Proceedings Linn. Soc., vol. 4, 1860, p. 117. His report is in Annales Mus. Nat. Hung., vol. 12, 1914, p. 674. The type is headless, but the hind tibia has a

long curved apical spur (mentioned by Walker), and Kertesz states positively that *Cadrema*, of which it is the sole species, must take priority over *Hippelates*. No one seems to have seen another specimen of *lonchopteroides*, which is strikingly marked in having an apical dark spot in the wing. Becker's *Parahippelates fuscipleuris* from New Guinea, has such a spot, but from the description seems to have longer plumosity on the arista. From existing data by Walker and Kertesz, I believe *lonchopteroides* is nearly related to the widespread *Prohippelates pallidus* Loew, and is far more likely to be congeneric with it than with *Hippelates plebejus*. I therefore continue to use *Hippelates*, leaving *Cadrema* for elucidation when additional material of the type species shall have been discovered. I am indebted to Mr. Malloch for calling to my attention the occurrence of *pallidus* in the Pacific region; it is evidently the same species which Becker identified as *Hippelates nigricornis* Thoms., in his work on Indo-Australian Chloropidae, Annales Mus. Nat. Hung., vol. 9, 1911, p. 103. Malloch reported it from Samoa (insects of Samoa, Chloropidae, 1930, p. 245).

Hippelates pallipes Loew.

I have just mentioned that Loew published this as an *Oscinis*. The type was from Cuba (Gundlach). He published *Hippelates flavipes* in Berliner Ent. Zeitsch., vol. 10, 1866, p. 184 (Centuries, pt. 6, No. 95); this species was also from the same collector in Cuba. His type series contains two species, his own *pallipes* and in minor part *partitus* Becker. I designate the part agreeing with *pallipes* as the true types, believing that less confusion will result from sinking the name *flavipes* than from transferring it to another species.

Hippelates currani, new name.

I propose this for *Hippelates collusor* Curran, Amer. Mus. Novitates, No. 220, 1926, p. 4. Townsend described *Oscinis collusor* from Lower California, in Proceedings Cal. Acad. Sci. sec. ser., vol. 4, 1895, p. 619. His type was in the California Academy and was destroyed in the San Francisco fire; I had examined it a few months before, but did not get enough of a description to place it except as to the genus. It is a *Hippelates*, as might be surmised from his statement that the species annoys people, causing irritation of the eyes.

I have recently identified three specimens of *currani* that were sent by Dr. A. da Costa Lima, of Rio Janeiro, who received them from Dr. M. Florentino da Silva, of Parahyba do Norte, Brazil.

Hippelates plebejus Loew.

The relationship with *nobilis* and *proboscideus* is not altogether clear, but I identify the last-named in a series of 13 from Higuito, Costa Rica (Schild), and six from Panama (5 Trinidad River, 1 Boqueron River, all collected by Busck); having examined the types of *nobilis* and *plebejus*, I tentatively separate the three species as follows:

Scutellum bordered with reddish.. *plebejus*.
Scutellum wholly black, concolorous with mesonotum.
  Hind femora and tibiae ringed with brown; cheek one-third
    eye-height.. *nobilis*.
  Hind femora and tibiae wholly or almost wholly yellow;
    cheek one-fourth eye-height .... *proboscideus*.

In *nobilis* the ocellar triangle may not show the shining black spot in the apex, and if present it may be narrow as indicated by Loew; in *proboscideus* it is present and rounded in all the specimens seen. *Proboscideus* shows no characters to justify the subgenus *Siphomyia* which Williston based upon it, and which Duda in his recent paper cited above elevates to full generic rank.

Hippelates longulus Becker.

Described in his work on the nearctic Chloropidae (Ann. Mus. Nat. Hung., vol. 10, 1912, p. 89). The single type, a female, was returned to me. Becker made a mistake in the locality, calling it Canada, when it is Grenada, W. I.; it should have been in his neotropical paper.

I have carefully examined the type, and can make it out to be nothing but a specimen of *capax* Coq., which Malloch has made the type of the new genus Pseudohippelates.

Hippelates brasiliensis, new species.

Resembles *Hippelates pallidus* Loew, but has narrower cheeks and has distinct white pollen on the parafacial and upper part of cheek.

Thorax shining black, including pleurae; frontal triangle shining black, large; legs wholly pale yellow, only the last tarsal joint sometimes brownish.

Male, female. Frontal triangle large, highly polished, its upper angles barely separated from the eyes, its sides convex, the tip sometimes yellow, almost touching anterior edge of front. Lower part of front yellow, becoming brownish upward. When viewed from in front and a little below, the parafrontals are white pollinose like the parafacials. Antennae pale yellow, third joint wider than long, its upper edge infuscated; arista yellow on basal joint, the remainder black and distinctly pubescent under moderately high power (20 diameters). Face dark in middle; palpi yellow, rather large; proboscis

brownish black, the main segment considerably shorter than head, labella of about equal length, folded back; inner edge of mouth dark. Cheek yellow, in side view about one-eighth eye-height, without prominent angle in vibrissal region; when viewed more from below, the lower third is shining, the rest white pollinose.

Thorax with a median row of hairs arising from punctures; next to this laterally a less distinct row not in punctures; then a row, somewhat double posteriorly, arising from conspicuous punctures giving almost the effect of a groove (all this is the same as in *pallipes*). Scutellum with the normal two minute bristles at tip.

Abdomen polished black, the base yellow for about two segments.

Legs very pale yellow, with hairs of same color, only the tibial spurs and claws black. Hind tibial spurs arising at five-sixths the length of the tibiae, which they hardly surpass.

Wings hyaline, veins very pale, costa a little darker.

Length, 1.4 to 1.6 mm.

Described from 25 specimens of both sexes received from R. C. Shannon; he writes that they were collected at the city of Parahyba, State of Parahyba, Brazil, by Dr. Eduardo Araujo, who suspected that they may be conveyors of the disease called Yaws.

Type.—Female, Cat. No. 43456, U. S. N. M.

Four of the paratypes are deposited in the Instituto Oswaldo Cruz, Rio Janeiro; four in the Instituto Biologico, Sao Paulo; and four are returned to Mr. Shannon.

BIOLOGICAL NOTES ON THE TRIGONALIDAE (HYMENOPTERA).[1]

By CURTIS P. CLAUSEN,
Senior Entomologist, United States Department of Agriculture.

In a recent paper the writer presented an account of the life history of *Poecilogonalos thwaitesii* (Westw.), parasitic in the cocoons of *Henicospilus* in India. The life history as given was incomplete, lacking information on the hatching of the egg and on the characteristics of the primary larval stage. The present paper deals with these two points in two genera, *Poecilogonalos* and *Orthogonalos*, studied in Japan.

MANNER OF OVIPOSITION.

The leaf-ovipositing habit in the Trigonalidae was first demonstrated by Mr. Cho Teranishi in the case of *Poecilogonalos*

[1]Clausen, Curtis P., Biological Studies on *Poecilogonalos thwaitesii* (Westw.) Parasitic in the Cocoons of Henicospilus (Hymen.: Trigonalidae), Proc. Ent. Soc. Washington, Vol. 31, No. 4, pp. 67–79, 1929.

maga Teranishi, in 1921 (see Teranishi, 1929), and the writer has since noted a similar habit in *Poecilogonalos thwaitesii* (Westw.), *P. henicospili* Rohwer, *Orthogonalos debilis* Teranishi, and *Pseudogonalos* sp. It would therefore seem probable that this type of oviposition is general in the family.

The manner of oviposition is uniform in all of the species observed, and is here illustrated in Fig 1. The female stands on the upper surface of the leaf and curves the tip of the abdomen underneath the margin, the egg then being placed on the lower side at a distance of 0.5 to 1.0 mm. from the edge.

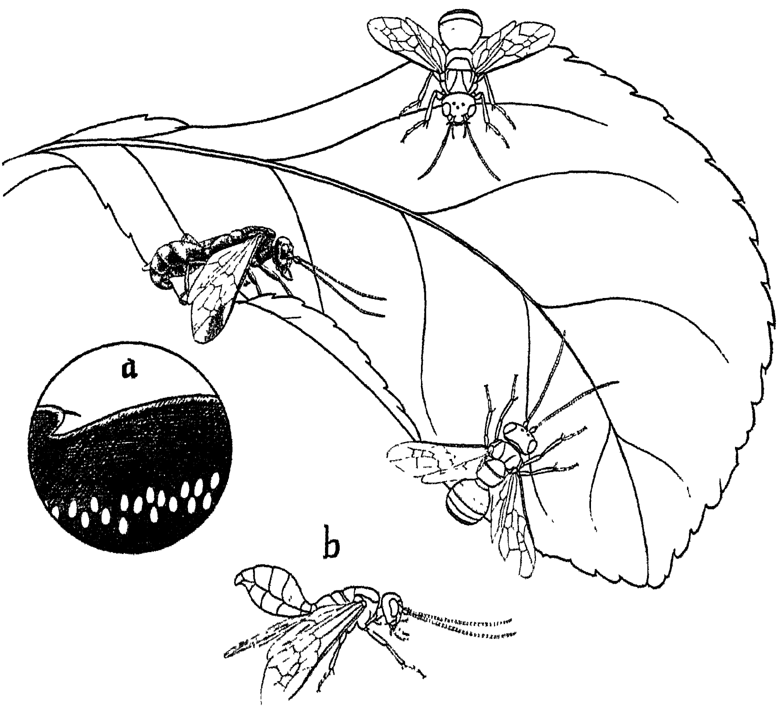


FIG. 1. The manner of oviposition in the Trigonalidae (*Poecilogonalos maga* figured, x 2.5). *a*, A typical row of eggs beneath the margin of a leaf of *Rubus palmatus* Thunb. *b*, The characteristic resting position of the female, the wings also being held in this position while in movement on the leaf or in the act of oviposition. (*Drawing by Y. Hasegawa.*)

The rate of oviposition is very rapid and egg laying extends over a considerable period of time. Teranishi[1] records the

[1]Teranishi, C., Trigonaloidea from Japan and Korea (Hym.). Insecta Matsumurana, Vol. No. 3, 4, pp. 143–151, 2 pl., 1929.

deposition of 3,599 eggs in 4 days by a female of *Poecilogonalos maga*, while the writer secured 10,641 during a period of 14 days from *P. thwaitesii* and with another individual of the same species 4,376 in a single day, and in the case of *P. henicospili* 5,782 were deposited in a period of 6 days. The normal reproductive potential in this genus is thus probably at least 5,000, assuming numerical equality between the sexes.

Plants Selected for Oviposition.

Observations have not been sufficiently extensive to permit of any general conclusion with respect to the factors involved in the choice of plants for oviposition. In the case of *P. maga* it is known that at Jozankai, Japan, in 1921 the eggs were placed almost exclusively upon the leaves of red clover, whereas at Shimajima, in 1928, oviposition was largely restricted to *Rubus palmatus* Thunb. Experiments in India upon *P. thwaitesii* indicated quite conclusively that the physical qualities of the leaf had a direct bearing upon the readiness with which the females would oviposit thereon. It is perhaps probable, however, that this factor is of secondary consideration, and that the primary influence is related to the presence of the secondary hosts upon the plants chosen for oviposition. It has not thus far been possible to investigate this phase of the problem, but its relation to the bionomics of the family is evident as bearing upon the frequency with which contact with the primary host is eventually attained.

The Egg.

In *Poecilogonalos maga* the egg (see Teranishi, 1929, pl. 6, fig. 5, 5a), is 0.1 mm. in length and 0.06 mm. in width, flat on its ventral surface and arched dorsally, and with a series of from 8 to 10 longitudinal ridges on the surface of the chorion, of which 1 or 2 may be branched. The egg of *P. thwaitesii* (see Clausen, 1929, pl. 5, fig. 2), is of somewhat similar form, though slightly more arched dorsally, and with the longitudinal ridges only 6 in number, the median 4 uniting at the anterior end. The egg of *P. henicospili* is of practically identical form. That of *Orthogonalos debilis* is 0.13 mm. in length, 0.07 mm. in width and flatter than in the above species. The chorion is somewhat translucent in contrast to its markedly opaque quality in *Poecilogonalos*, and the longitudinal ridges, while present, are irregular and indistinct.

Incubation and Hatching.

In the earlier experiments upon *P. maga* and *P. thwaitesii* it was found that the eggs deposited upon foliage by females

known to be fertile invariably failed to hatch, though dissections revealed them to contain apparently fully developed and living embryos even several months after deposition. This led to the assumption that the eggs must of necessity be eaten by the secondary host before the necessary stimulus to hatching is provided. In none of the species dealt with to date has the secondary host been known with certainty, and the primary host has been known in the case of *P. thwaitesii* and *P. henicospili* only, consequently the normal cycle could not be reproduced experimentally.

Under the assumption that the salivary or digestive juices of the secondary host provide the stimulus essential to hatching, a series of experiments was conducted with various chemicals in an attempt to simulate normal conditions. At first this experimentation was entirely fruitless, but later it was found that unless the chorion was first ruptured no effect from the chemicals could be secured. This was easily accomplished by exerting a slight pressure upon a cover glass resting upon the eggs, resulting in a longitudinal split between the surface ridges. It is quite probable that this is the precise effect attained through mandibular action by the secondary host larva at the time of the ingestion of the eggs.

With this initial assistance it was found that the larva would rupture the inner membrane and emerge from the egg when immersed in a very weak solution of potassium hydroxide. These experiments indicated the probable course of events, and it was then necessary to test this interpretation by the use of substitute secondary hosts. For this purpose a number of Papilionid larvae were collected and fed with foliage of their normal food plant upon which had previously been placed a quantity of eggs of either *Poecilogonalos maga* or *Orthogonalos debilis*. These host larvae were then dissected at periods ranging from 1 to 6 hours after feeding.

In these dissections it was found that within 1 hour following ingestion several of the eggs had hatched; and that 4 hours after feeding, in the case of the host examined, 13 active larvae were found in the anterior portions of the digestive tract, 2 had penetrated into the body cavity, and 10 still remained unhatched. In another instance a considerable number of unhatched eggs were voided with the excrement. An examination of these failed to reveal any break in the chorion, though living larvae were found within them.

Following these experiments a search was made for caterpillars and sawfly larvae upon foliage in the locality at Shimajima where *P. maga* was known to be common. Among those secured was a single sawfly larva which, upon dissection, revealed in the body cavity 3 Trigonalid larvae of the first stage, which

were identical in form with those of *P. maga* secured experimentally and by dissection of eggs in the laboratory. It is not implied, however, that this sawfly is the normal secondary host, as hatching of the Trigonalid eggs, within certain limits, very probably occurs in the larvae of the majority of lepidopterous and hymenopterous species of phytophagous habit found upon the particular oviposition plants. The restrictive factor is more likely to be found in a consideration of the biology of the primary parasites which attack the secondary hosts ordinarily ingesting eggs of *P. maga*.

In view of the above results, in conjunction with the dissection data secured with *P. thwaitesii* in India, it may be asserted with considerable confidence that the normal cycle of *Poecilogonalos*, and very probably other Trigonalid genera as well, is (1) the deposition of the egg upon foliage, (2) its ingestion by the secondary host (either caterpillar or sawfly larva), (3) its hatching within the digestive tract, (4) the penetration of the Trigonalid larva into the body cavity of the secondary host followed by its penetration of the derm of the primary (Ichneumonoid) host if present, and finally (5) its eventual emergence in the fourth larval stage from the prepupa of the latter, which at this time is within a cocoon in the soil. Feeding is completed externally and an irregular cocoon spun within that of the primary host.

The Primary Larva.

In the case of *P. thwaitesii* it was stated, in the paper dealing with that species, that the partially developed embryos, as found by dissections of eggs, indicated the primary larva to be of the planidium type and in general similar to that of *Perilampus*. It is now known that the form observed was fully developed, rather than being an intermediate embryonic stage, and was in all essential respects similar to the primary larvae here described and figured for *P. maga* and *Orthogonalos debilis*. In view of the fact that both hatching and development take place internally, the main requirements of the primary larva are the power of locomotion in a fluid or semifluid medium, and of penetration, first of the wall of the digestive tract and then of the derm of the primary host. Lacking the requirement of mobility on a plane surface externally, its morphological characteristics are markedly different from those of a planidium.

The primary larva of *P. maga* (fig. 2, A) is 0.12 mm. in length, with 12 body segments, and is widest in the mid-thoracic region. The head is broadest at its juncture with the thorax, somewhat retracted into the first segment, and with the slender mandibles largely extruded. The first thoracic segment has a transverse row of 5 heavily chitinized hooks ventrally, directed caudad,

the lateral hairs being successively slightly smaller. Dorsally is a large palmate and heavily chitinized plate, attached at its anterior half, and with the free portion apparently comprising a double series of "teeth," as figured. The second segment has a transverse row of rather small, stout spines ventrally, 8 to 9 in number. Slightly laterad of each end of this row is a group of 3 heavier hooks, directed latero-caudad. Dorsally is an irregularly set row of 8 or 9 hooks which are considerably larger than those of the ventral row. The third segment bears a transverse row of ordinary setae ventrally, a dorsal row of hooks similar to those of the preceding segment, and a few delicate setae at each end of the row. The abdominal segments have ventral and dorsal rows of setae, these forming a complete ring on the last 2 or 3 segments only.

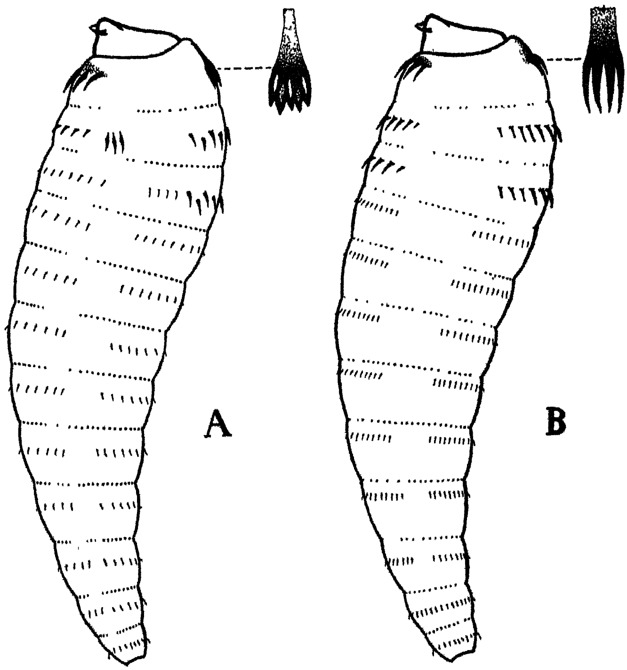


FIG. 2. The primary larval stage; (A) *Poecilogonalos maga* (x 625), (B) *Orthogonalos debilis* (x 625).

The primary larva of *Orthogonalos debilis* (fig. 2, B) is of similar form but with several minor distinguishing characters. The palmate plate of the first thoracic segment is apparently simple, with 4 teeth. The ventral row of hooks is present on

the third as well as on the second segment, and these are heavier than those on the second segment of *P. maga*. The group of 3 heavy hooks at the lateral margin of the second segment is lacking.

Host Relationships.

From the relatively few rearing and collection records available with respect to the Trigonalidae we find that these parasites are limited to three groups of primary hosts, the Tachinidae, the Ichneumonoidea, and the Vespoidea. The course of development as a parasite in the Tachinidae is probably identical with that in the Ichneumonoidea. As to the Vespoid hosts we are faced with some difficulty. In no instance does the record establish beyond doubt that the one given is the true host, and the individuals which emerged may have come either from a lepidopterous scavenger or from some other insect in the nest. A consideration of the possibilities, however, would indicate that the records for this group of hosts are authentic. On the basis of our present knowledge it may be assumed that the Trigonalid species concerned deposit their eggs upon foliage, and that this necessitates the eggs being eaten by some phytophagous larva. The scavengers found in the Vespoid nests do not fulfill this condition. It is conceivable that an occasional parasitized caterpillar might find its way into the nest, but that this should occur frequently in the same nest is improbable.

On the assumption that these host records are correct the only logical explanation of the mode of access of the Trigonalid larvae to the wasp larvae in the nest is that they enter through the agency of the parent wasp herself. The Vespoid adults, being of entomophagous habit, may take these minute Trigonalid larvae into the crop along with the body fluids of the caterpillar carrier, and they may thus be transported to the nest and fed to the Vespoid larvae, following which development would proceed normally.

It appears logical to assume that the species recorded as having been reared from Vespoidea are normal parasites of Ichneumonoidea, of which a portion have been diverted to another host. The first-stage larvae occur in the body of the phytophagous secondary host in the course of progress to the primary but, through the consumption of the body contents of the secondary host by a Vespoid adult, they are included in the regurgitated food given to the wasp larvae. These last, being closely related to the supposed normal host, provide a suitable medium for development.

The successive steps in the life cycle of the Trigonalidae in the three groups of hosts (hypothetically in the case of Vespoids) may be outlined as follows:

Trigonalid female.

Eggs deposited upon foliage.

Eggs eaten by caterpillars or sawfly larvae.

Larvae parasitized by Ichneumonoid (before or after eggs have been eaten).	Larvae eaten by adult Vespoid.	Larvae parasitized by Tachinid (before or after eggs have been eaten).
Primary trigonalid larva penetrates body of Ichneumonoid larva.	Body fluids of larvae, containing primary trigonalid larvae, fed to Vespoid larvae.	Primary trigonalid larva penetrates body of Tachinid larva.
Develops within Ichneumonoid larva.	Develops within Vespoid larva.	Develops within Tachinid larva.
Adult emerges from Ichneumonoid cocoon.	Adult emerges from Vespoid cell.	Adult emerges from tachinid puparium.

With the above mode of development in Ichneumonoid and Tachinid hosts the question arises as to why this family of parasites does not develop on these hosts irrespective of what the secondary host may be, providing only that it is of phytophagous habit. The Scarabaeidae, with their Tachinid and Ortalid parasites, immediately come to mind. In Japan in recent years vast numbers of parasitized *Popillia japonica* beetles have been collected, largely in localities where Trigonalidae are known to occur, yet not a single Trigonalid has been reared from this material. The explanation may lie either in the failure of the beetle to break the egg chorion, or in the lack, in the fluids of the digestive tract, of the requisite chemical components to induce activity.

MORTALITY FACTORS.

The mode of development shown for several species of *Poecilogonalos* as indirect parasites of phytophagous larvae reveals an unusual series of factors causing mortality, the aggregate effect of which is to necessitate an exceptionally high reproductive capacity to maintain the numerical status of the species. The more important of these factors may be listed as follows:

1. The egg may be deposited on host plants not frequented by larvae of the secondary host. This is an uncertain factor, as already stated, and may be of little importance.

2. If deposited upon the proper plant species the eggs may not be eaten by the secondary host larvae. This factor is considered to be the most important of the series in that it is dependent not only upon the presence of the secondary host larvae but upon their numerical abundance as well. The placement of the eggs at the margin of the leaf enhances the chance of their being eaten, as the greater proportion of leaf-feeding larvae begin feeding at that point. If only a single secondary host larva is present on the plant the chance of its consuming one or more eggs is more or less in proportion to the dispersion of the Trigonalid eggs upon the foliage. From the viewpoint of maximum survival, a single egg upon each leaf would give the greatest chance of success. The optimum condition would also seem to be provided by secondary host species of gregarious habit.

3. If eaten by suitable secondary host larvae a portion of the eggs may not hatch in the digestive tract. This factor, of rather uncertain value, is probably more or less constant within any single secondary host species, but may vary considerably between species owing to difference in form of mandibles and the manner of feeding. It may be assumed that larvae which swallow their food in large fragments will rupture the chorion of fewer eggs than those which masticate it more thoroughly. Thus, also, the earlier-stage larvae are probably more effective than the larger mature ones.

4. The secondary host larva which consumes the egg may not contain a primary parasite larva. The percentage of successful parasitism upon the primary host may be considered to be in direct ratio to the proportion of secondary host larvae which have eaten Trigonalid eggs. Thus, if 50 per cent of the secondary host larvae consume these eggs then, by the law of chance occurrence, the effective parasitization of the primary host will be of the same value. The third factor mentioned above is here disregarded, it being offset by superparasitism.

5. Superparasitism. This factor accounts for a considerable mortality in the early larval stages, as was shown in the case of

P. thwaitesii in India. With a 54 per cent field parasitism upon the Henicospilus host an average number of 1.8 larvae of the third stage were found in each host, as determined by dissections of living material and an examination of the remains in empty cocoons. In the third stage cannibalistic tendencies are most pronounced, and it is probable that the individuals which first attain this stage effect a considerable, further mortality upon the second stage, which is defenceless. Owing to their delicate and unpigmented integument the remains of these latter could not be distinguished in dissections of the primary host larvae.

Because of the manner of oviposition a considerable number of eggs may be placed upon a single leaf and all eaten by a solitary secondary host larva. So far as known the Trigonalidae dealt with are solitary parasites of the larger Ichneumonoidea, which are themselves mainly solitary, so that irrespective of the number of eggs eaten only a single one can develop to maturity.

The above mortality factors are those which enter into the problem where an Ichneumonoid is the primary host. They are probably of identical value in relation to the Tachinid species attacked. In connection with parasitism of Vespoidea, and the assumed cycle of events as outlined, other factors enter, and the fourth mentioned above is eliminated.

THE OVIPOSITION HABITS OF FELTIA SUBGOTHICA HAW. (NOCTUIDAE, LEP.).[1]

By W. V. BALDUF. *University of Illinois.*

For several years I have been finding a species of *Copidosoma*[2] frequenting the flowerets of various *Helianthus* species at Oak Harbor, Ohio, during the latter part of August. While making a search in 1930 for the possible hosts of this Chalcid, I frequently discovered the eggs and very small larvae of a moth in *Helianthus* heads taken at Oak Harbor and West Lafayette, Ohio, and at Urbana, Illinois. Specimens of larvae hatched from the eggs found in these flowers at Urbana were reared to the moth stage. They proved to be the Noctuid, *Feltia subgothica* Haworth. Incidentally, no *Copidosoma* sp. was obtained from the eggs or larvae of this cutworm. A survey of the literature dealing with the habits of American species of *Feltia* and the foreign forms recorded in the Review of Applied Entomology revealed no information regarding what is probably the true habit of

[1]Contribution from the Entomological Laboratories of the University of Illinois No. 151.

[2]Determined by A. B. Gahan, U. S. National Museum.

depositing eggs. Records of oviposition reported in various papers refer to observations on caged moths, which, in view of the present finding, obviously performed abnormally due to the absence of the oviposition plants selected in nature. The following is a summary of my findings, together with pertinent notes from the literature relating to the egg-laying habits and development in this genus in general and *Feltia subgothica* Haw. in particular.

IDENTITY OF THE MOTH.

Specimens of moths submitted to Doctors Schaus and Heinrich of the United States National Museum for identification brought their report as follows in a letter from Doctor Harold Morrison: "The smaller specimens are *Feltia ducens* Walk., the larger specimens *F. subgothica* Haw. These are probably variants of one species, *F. subgothica* Haw. having priority. The larvae and genitalia are similar in both forms." The smaller specimens referred to by these specialists were taken between September 12 and September 30, 1930, flying about *Helianthus* flowers growing in a certain bed in the gardens of the floriculture division of the University of Illinois. No other moths of this genus were found there or in that neighborhood during that period. Many eggs and newly hatched larvae occurred in the flowers of the same bed at the same time. From these eggs were reared all the larger specimens mentioned in the above letter and identified as *Feltia subgothica* Haw. These findings confirm the conclusions of Schaus and Heinrich that *ducens* and *subgothica* are probably variants of one species.

LIFE HISTORY OF FELTIA.

Of the twenty species of *Feltia* listed in Barnes and McDunnough, Check List of Lepidoptera of North America, only three seem to be fairly well known in the United States. These are *Feltia annexa* Treitschke, the granulated cutworm, *F. gladiaria* Morr., the clay-backed cutworm, and *F. ducens* Walk. and herein called *Feltia subgothica* Haw., long designated as the dingy cutworm. Their stages, and more or less of their seasonal development, have been described. All possess the cutworm habit, but may at times climb upon plants, including fruit trees to feed on the leaves. All are general feeders, consuming weeds, field crops and vegetables.

Jones (1) found apparently five and possibly six generations annually of *F. annexa* at Baton Rouge, while in Illinois, Forbes (2) took moths of this species in July to August, and again in August to September, the latter ovipositing before winter, indicating the occurrence of two generations in this latitude.

It seems to winter as a larva and is most destructive in April or May.

Doctor Forbes (3) found that *F. gladiaria* Morr. winters as a partly grown larva in the latitude of Urbana, Illinois, and is destructive from the middle of April to the beginning of June. By the middle of June all larvae have entered the earth for transformation, but have been observed to remain there as larvae in a torpid state for more than six weeks. Moths consequently do not appear until September and early October. Eggs are laid promptly, and only one generation develops in a year.

Feltia subgothica Haw. occurs throughout the United States and in all the Canadian provinces, according to Professor Slingerland (4). Forbes (3) took moths of this species during all of July, August and September, but found it most abundant in the latter part of August. Oviposition follows closely upon emergence of the adult, the eggs hatch promptly, and the larvae are quite small to a half inch long during the winter. Growth is rapid in warm spring weather, and maturity is attained mostly in the first half of June, when they enter the ground. Here they spend an unusually long period in preparation for pupation. The life history accounts given by Slingerland for New York and by Gibson (5) for Canada agree in all essential respects with that by Forbes.

It will be noted that *F. gladiaria* and *F. subgothica* have one generation in a year, and their several stages run closely parallel with regard to seasonal occurrence. In each of these species there is a pronounced delay between entrance of the mature larvae into the soil and their pupation.

OVIPOSITION.

The eggs of all these species have been obtained, but no mention is made of the place of deposition, except by Jones (1, p. 10), who writes concerning *F. annexa* that "no eggs have been collected in the field. In the insectary they were deposited at night singly over objects to which the moths had access, with the flattened side of the egg adhering to the surface upon which it rested. Riley has stated that moths which he had under observation scattered their eggs irregularly and singly on grass, though he considered this habit exceptional and probably abnormal, as the result of confinement. * * * Once egg-laying had begun, eggs usually were deposited every night during the period of oviposition." A series of moths observed by Jones deposited from 311 to 1374 eggs per individual. Theobald (8) states that the moths of *F.* (*Agrotis*) *exclamationis* L. appear in England in June and July and lay their eggs on leaves near the soil or actually on the soil. Dyar (7) reports seventy-five specimens of *F. vancouverensis* Grote taken from May 31 to July 28,

and describes the egg. Slingerland (4, p. 578) tabulated captures of *F. subgothica* at Ithaca, New York, for 1889 and 1892. Moths came to the traps from July 4 to September 18 in 1889 and from June 24 to September 30 in 1892, the largest numbers appearing during the latter half of August in each year. Inasmuch as oviposition follows soon after issuance from the chrysalises, these records are significant for the dates of oviposition. Slingerland (p. 577) describes the egg. All his attempts to secure egg deposition failed excepting that one moth laid ten eggs on clover leaves in a bottle. Crumb (6) reports that the main flight of *F. subgothica* (*ducens* Walk.) takes place in Tennessee between September 10 and October 10, whereas in Illinois, Iowa, New York, and Canada the main flight occurs between August 15 and September 5.

The presence of the eggs of *F. subgothica*, in abundance, in the flowerets of various *Helianthus* species is regarded as evidence that the normal manner and place of oviposition of this species is to deposit them into flowerets rather than on leaves and stems of plants or on the soil, as is the common habit of many cutworm moths. In 1930, I dissected numerous flowerets of different *Helianthus* collected at Oak Harbor and West Lafayette, Ohio, in latter August, and at Urbana during September and early October, the results of which studies are given hereafter. Eggs were found in the flowers from each of these localities.

The species of *Helianthus* containing the eggs of *F. subgothica* range in size from the common large sunflowers to the smaller types like *H. tuberosa*, or Jerusalem artichoke, growing in profusion along railroads for miles east of this city. *H. cucumifolia*, a species of intermediate size growing in the University gardens, yielded a large proportion of the eggs, but was visited more frequently than the other species. Despite the difference in size of the flower heads, the dimensions of the individual flowerets from the several species of *Helianthus* found to contain the eggs were more or less uniform. The petals of *Helianthus* are united, as are also the flattened stamens, which form a narrow tube only a few millimeters in diameter. However, the bases of the filaments remain separated, leaving openings from the stamen tube into the bottom of the corolla. The anthers, which are free, and are drawn down into the stamen tube before the pollen is shed, discharge their masses of pollen into the stamen tube. These facts have significance in the economy of *Feltia subgothica*.

Most of the eggs found in flowers were taken from a small bed composed of *H. cucumifolia* and another undetermined form of this genus in the University gardens in September, 1930. The moth was not observed in the act of oviposition, but a series of *subgothica* having been reared from eggs taken from these flowers, there can remain no doubt that oviposition by this

species took place in these flowers. The smaller, lighter color variant of this moth, was one of the common species of Noctuidae in the garden in September. Several hours were devoted to observing the moths in the early part of the nights of September 12 and 15. They flew about the flowers, but spent most of the time at rest on the heads and in inserting their siphons into the corolla tubes of the *Helianthus*. Many other blooming ornamentals, chiefly moss rose, heliotrope, zinnia, sweet alyssum, marigold, petunias, and lantana, growing in the immediate vicinity of the *Helianthus* were, strange to say, not visited at all by these moths. Other species of Noctuidae were actively sipping nectar from a variety of blossoms, but *F. subgothica* confined its attention to the *Helianthus*. On other nights this insect occurred commonly on members of this group blooming in my own garden.

The act of placing the eggs in the flowerets represents a considerable degree of precision on the part of the moth and suggests that it is an old, well-established habit. Careful dissections of one thousand flowerets taken at Oak Harbor and West Lafayette, Ohio, and at Urbana, Illinois, from August 25 to October 7, 1930, produced eighty-six instances of infestation by eggs or newly hatched larvae of *F. subgothica*, their occurrence being distributed throughout the above period. In all excepting two of these cases, the eggs had been deposited into the small anther tubes. The much larger and more easily accessible corolla contained the eggs in the other two instances. It is obvious that considerable accuracy of manipulation is required of the moth to thrust her ovipositor into so small a tube. Naturally one wonders why the larger corolla tube is not selected for oviposition.

The number of eggs per anther tube varied from one to eight, with three to six common. The average for the infested flowerets is near three, and about eight per cent of the flowerets dissected contained eggs. In practically all instances, the eggs, regardless of the number per floweret, were placed in the lower half or lower two-thirds of the stamen tube. Usually they were found in a rather straight row or column, but the individual eggs assumed many positions, being attached to the walls of the stamen tube by their sides as well as their upper or lower surfaces. Less often the eggs had been pushed down in an irregular mass at the bottom of the tube, which not infrequently caused the sides of the tube to bulge out prominently, and in one instance the wall of the tube was actually broken. When four to eight eggs occupied a single tube, it was not uncommon to find two or more of them poked out through the openings at the bottom of the stamen tube into the corolla. The fact that the eggs, regardless of number per tube, occur in the lower part

suggests that the moth introduces the full length of the ovipositor into the flower when depositing them.

OBSERVATIONS ON THE LATER STAGES.

One particular lot of eggs removed from a single flower head were obviously newly deposited. They hatched in ten days in room temperatures during early September. None of the several hundred eggs obtained failed to hatch. Some already had hatched when they were found. The newly emerged caterpillars commonly remove most of the egg shells, judging by the fragments often left. The shells appear to be sticky when the eggs are laid. The part that makes contact with the wall of the stamen tube usually remains intact when the rest has presumably been eaten. Invariably, the stamen tubes containing newly hatched caterpillars also contain at that time a good supply of fresh pollen, which suggests that the female moth has a rather keen sense for the selection of flowerets that are in the most advantageous state of development for her progeny. The new larvae remain, for perhaps several days, in the stamen tube. Strangely, their food preferences at this time are markedly at variance from those of their later larval life as cutworms which eat a great range of both noxious and useful plants. In the stamen tube they consume three parts of the flowerets. As long as the pollen supply lasts they use it as food. It was commonly observed that several small, first instar larvae were feeding in one tube. Neither in this instar, nor in any other during the larval stage, when a number of larvae were kept in close confinement, was there observed the least evidence of a cannibalistic tendency. There is distinct evidence that larvae originating in one tube may subsequently migrate to adjoining stamen tubes and eat the pollen there. Pollen is the chief food while the larva lives in the flower. Considering this, one can readily see the advantage of depositing the eggs into the stamen tube rather than in the corolla. In addition to the pollen, the small larvae sometimes also eat the black strap-shaped pieces that help to form the stamen tube, and less frequently the fleshy receptacle is gouged to some extent. No evidence was seen to show that they eat the seeds. Another caterpillar which, judged by its plump form and pink color, seemed to be mature in early September, frequents the heads of *Helianthus*. When small it enters the seeds from the receptacle to eat out the cotyledons, several of which are consumed by one larva, and spins a run way on the tops of a group of seeds when it reaches maturity. This is a different habit from that of *F. subgothica*. Efforts to rear these insects have not been successful. The mature larva is similar to a full-grown codling worm in color and form, but somewhat smaller. It is much less common than *subgothica*,

and was present in a series of heads of common sunflower, and Jerusalem artichoke at Urbana.

The larvae of *F. subgothica* uniformly left the flowerets and heads of *Helianthus* while they were still in the first instar. In this instar they travel in a semi-looping manner, and are moderately clothed with rather long hairs. It was not possible to trace them after they left the flower head. No evidence could be found to show that they eat the leaves of *Helianthus*. The larvae exhibited a strong negative reaction to light in all their instars, which suggests that the small larvae get down to the ground and hide under plants or in the soil in the day time after forsaking the place of their origin. While tender foliage of *Helianthus*, including Jerusalem artichoke, was at hand they thrived on it in cages. They refused to eat the fleshy roots of the artichoke. After frosts killed the *Helianthus* the larvae were carried through on greenhouse lettuce without any difficulty. If there is a natural pause in development for the hibernation period it did not become apparent in the two lots of larvae reared to maturity under insectary conditions.

The larvae began to reach full size and fed less voraciously shortly before Christmas, having developed from eggs collected on September 11 and 15, 1930. During the first half of their larval stage they ceased to crawl in the semi-looping manner, and a row of V-shaped bars appeared on the upper surfaces of the body segments. As recorded by Doctor Forbes, the larvae enter the soil where they delay pupation for a considerable number of days. The pupal cells are oblong-oval in form and without silk lining. Those in my cages descended about two inches into the loose moist soil provided. There was not definite uniformity in the time of pupation or of emergence of the adults reared from a given lot of the same age. The first moth issued on January 20, from the first lot, and the first of lot two appeared on February 5. The dates of emergence have, of course, but little value because the rearing conditions were not natural. According to Forbes, this species passes the winter as partly grown larvae, and the adult normally appears chiefly in August and September. The moth was prone to remain quiet and sometimes appeared to feign death when disturbed in the cages during the day.

Aside from the interest in the oviposition habits of the moth and the food and habitat of the first instar larva, the choice of places for depositing eggs has significance due to its bearing on the economic importance of this moth. Various wild species of *Helianthus*, notably *tuberosa*, grow plentifully near Urbana along the fences separating fields, by the roadside, and on railroad grounds. If it is generally true that *Feltia subgothica*, and probably some of its close relatives also, are limited to the flowerets of *Helianthus* or similar wild Compositae for oviposi-

tion, infestations of cultivated crops may be expected to arise and be most severe at first in those parts of fields adjoining areas in which these plants are growing. Furthermore, it may reasonably be expected that the adult stage of the moth is concurrent with the blocming period of these *Helianthus* species selected for oviposition, and that only one generation develops annually in moth species with this oviposition habit. Should the moths be obligated in nature to deposit their eggs only in such flowers, the control of the cutworms could be effectively accomplished by keeping the borders, or neighboring areas, of fields free of the ovipositional plant. Professor Forbes (3, p. 27), speculating on the possible bearing of the place of oviposition on the subsequent damage by the larvae, writes that "there is some reason to believe that the moth may lay her eggs in fall among the succulent weeds in the corn field, particularly when a severe drouth has made the pasture and meadow lands less inviting. In accordance with this supposition these cutworms have not infrequently been found in early spring generally distributed through corn on old corn ground." Is it not probable that the spring distribution of this cutworm will prove to be through areas nearest the occurrence of *Helianthus?* Their taste for a great variety of plants probably also facilitates their spread from the *Helianthus* infested centers.

LITERATURE CITED.

1. JONES, THOS. H., The Granulated Cutworm, an Important Enemy of Vegetable Crops in Louisiana, U. S. D. A. Bul. 703, part II, pp. 7–14, 1918.
2. FORBES, S. A., Corn Pests, Ill. Agr. Exp. Stat., Bul. 95, pp. 331–339, 1904.
3. FORBES, S. A., A Monograph of Insect Injuries to Indian Corn, part II, 23d Rept. State Ent. Ill., 1905, pp. 28–29, Figs. 10–11.
4. SLINGERLAND, M. V., Climbing Cutworms in Western New York, Cornell Univ. Agr. Exp. Sta., Bul. 104, pp. 574–579, 1895.
5. GIBSON, ARTHUR, Cutworms and Their Control. Dominion of Canada Dept. of Agric., Ent. Branch, Bul. 10, pp. 26–27, 1915.
6. CRUMB, S. E., Tobacco Cutworms and Their Control, U. S. D. A. Far. Bul. 1494, pp. 4–5, 1926.
7. DYAR, H. G., Lepidoptera of the Kootenai District of British Columbia, Proc. U. S. Nat. Museum, vol. 27, pp. 831–832, 1904.
8. THEOBALD, F. V., Some Soil Insects and Their Treatment, S. E. Agric. Coll., Res. and Adv. Dept., Bul. 5, 6 pp., Wye, Kent, Jan., 1927 (Abstract, R. A. E. A.).

MINUTES OF THE 427TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON.

The 427th meeting of the Society was held March 5, 1931, in Room 43 of the New National Museum. A. C. Baker, President, presided. There were present 47 members and 36 visitors. The minutes of the previous meeting were read, corrected, and approved.

S. A. Rohwer reported that a request had been granted from F. B. Colton, Editor, Associated Press Science, that his name be placed on the Society mailing list in order that an account of all the scientific papers of interest may be available to newspapers outside of Washington.

The first paper of the evening was by Mr. J. E. Graf, retiring President of the Society. The address was on "Some Problems in Entomological Administration."

This paper comprised a brief résumé of some of the more important considerations in the field of administration of an entomological organization comparable to the U. S. Bureau of Entomology. The introductory matter stressed the highly peculiar character of such a field, particularly the necessity for maintaining constructive cooperative relations with certain other designated organizations. In addition to routine work the necessity also was pointed out for contacts that must be made entirely outside the beaten path and illustrations of such were given. Then followed a discussion of the more fruitful types of investigation which profitably might be followed,—notably (1) a comprehensive investigation of the rôle of insects in transmitting diseases such as filterable viruses and various mosaics; (2) a program of work pertaining to biological control of insects, particularly the rôle of parasites and diseases in control of a given pest, the value of acclimatization, changed host relationships and new environments; (3) insect physiology also was pointed out to be a particularly difficult though promising field—in the near future its usefulness was indicated in the study of chemical control of pests; (4) developments in the increasing use of the term "ecology," such being not a new designation but merely a more exact use of an old subject bearing on the status of effect of climate and other environmental factors in insect development, the determination of the tolerance of insects to climatic changes, and the development of standards for the measurements of the more important considerations which make climate.

In summary it was stressed that "research is a gamble, good or bad, depending on the thought given to its planning and the intelligent care applied to its conduct." The standing of an administrator is determined from the character of the research in his charge as well as the direction of the more routine responsibilities in which he is enmeshed. The successful administrator should have the rare faculty of knowing people as well as problems, the real fruitage of successful administration being opportunity for service. (Abstract approved by author.)

Mr. Geo. P. Englehardt, of Brooklyn, N. Y., gave an informal talk on the Brooklyn Museum and his long connection with that institution. He mentioned the transfer of the collection of Lepidoptera from that museum to the U. S. National Museum. He spoke of the New York Entomological Society and its endownment of $12,000 for a publication fund; also the Brooklyn Entomological Society and its three main publications, viz., The Bulletin, The Glossary, and Entomologica Americana. There was mention made of the first three Directors of the Brooklyn Museum.

Mr. A. B. Gahan introduced a short systematic paper "On Certain Hymenopterous Parasites of Stored-Grain Insects," which will appear in the Journal of the Washington Academy of Sciences, by the following remarks: "I have been induced to present this paper before the society by three considerations: (1) To satisfy the cravings of the program committee for something filling and thereby to get them, temporarily at least, off my neck; (2) To demonstrate that in addition to his other accomplishments a taxonomist must be a detective, an international diplomatist, and an optimist; (3) To insure that the contents of this paper will be known in a general way at least to a few individuals aside from the four or five in the world who will be interested enough to read it. As to the first consideration, I can only hope that the committee will be so discouraged by this result of their effort that they will let me rest in peace hereafter. The second consideration needs some explanation. Apparently to some economic workers a taxonomist is a sort of up-to-date encyclopaedia which one has only to consult in order to find out all about some particular thing about which he knows nothing himself. If some lowly creeping thing arouses his idle curiosity by alighting on his hat, he immediately sends it to a taxonomist to find out what it is and whether by any chance it may be a wood infesting species. If the idea occurs to him that it might be interesting to know just how many pounds of animal matter on a given acre of soil is represented by insects, being perchance an ecologist with little else to do, he forthwith proceeds to trap, net, snare, or otherwise corral all of said insects and send them to a taxonomist for naming, for he must of necessity know their names in order to calculate how much they weigh. I am led to these conclusions by the amount and character of the material which comes to me. Since July 1, 1930, I have disposed of exactly 154 separate lots of parasitic Hymenoptera sent in for determination. On my desk at the present time are an even one hundred additional lots awaiting determination. These lots vary in extent from sendings of a few specimens to shipments comprising five Schmitt boxes. In character they run the gamut from specimens beautifully mounted and completely labelled with all data regarding host, locality, date, collector, etc., to specimens rolled up in a wad of glue in imitation of an amber fossil with such illuminating information as that they were collected while sunning themselves on the docks at New Orleans. Just why it should be necessary to know the name, habits, and ancestry of every microhymenopteron that happens to be unlucky enough to get caught trespassing upon a certain area of sugar beet field, pine forest, or piece of prairie sod at a given time is a mystery that has never been made quite clear to me. There are possibly close to a million species of parasitic Hymenoptera in the world, with possibly one-fifteenth of that number described. With perhaps a dozen individuals in the whole world professionally engaged in the classification and identification of these insects, it is easy to see what a simple matter the identification of such material becomes. As matters stand at present, the single chalcidologist at the British Museum and the one at the United States National Museum are probably handling more than half of the chalcidoid material collected the world over. What is true of taxonomists in parasitic Hymenoptera is true to a large extent, at least, of taxonomists in other groups. The professional entomological taxonomist today resembles nothing quite so much as a machine for grinding out names. Is it not clear that he needs must be an optimist not to become sunk in a sea of despond? The determination of a given species is not always

a mere matter of squinting down the barrel of a microscope and coming up with a correct name. It sometimes requires considerable sleuthing as well as international cooperation, to say nothing of months of correspondence as will be demonstrated by the paper I am about to present." (Author's abstract.) Dr. N. E. McIndoo made some remarks on this paper.

Mr. J. E. Graf made a few remarks on the work being carried on by Mr. S. E. Crumb. This work is on the European Earwig problem in the West. Most of the work is being carried on at Portland, Oregon, and Seattle, Washington. A great deal of attention has been given to bait.

Mr. Lee A. Strong, Chief, Plant Quarantine and Control Administration, spoke briefly to the Society.

Mr. P. H. Timberlake spoke of the migrations of certain species of chalcid flies that have taken place through commerce. From New Zealand a species of *Bruchophagus* was sent to him for determination which had been reared from the seeds of hemlock and fennel, together with its parasite, a species of *Tetrastichus*. Through the help of Mr. Gahan, this *Bruchophagus* was determined to be *Systole geniculata* Förster, which is known to be an important enemy of aniseed in Europe. As fennel occurs in the Hawaiian Islands, it was thought that the *Bruchophagus* ought to occur there also. Consequently, Mr. O. H. Swezey of Honolulu was asked to look for insects in the seed of fennel and not many months later reported success in finding both a *Bruchophagus* and a *Tetrastichus*, which prove to be identical with the New Zealand insects.

Dr. J. M. Aldrich announced that a new Entomological Journal is to be established at Sao Paulo, Brazil, by Mr. Thos. Borgmeir.

Mr. James I. Hambleton, of the Bee Laboratory, Somerset, Md., made a few remarks to the Society.

CHAS. T. GREENE,
Recording Secretary—pro tem.

REFERENCES TO MINUTES OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, 1918-1930, INCL.

Compiled by J. S. WADE.

By vote of the Entomological Society of Washington, at its 424th meeting, December 4, 1930, the Executive Committee was instructed to arrange for the publication of the minutes of the meetings of the society in its own Proceedings, beginning with January, 1931, thus conforming to procedure which has obtained from the first meeting, February 29, 1884, to the 305th meeting, January 7, 1917. Beginning with the 309th meeting, January 4, 1918, the minutes were published in the Journal of the Washington Academy of Sciences and this procedure continued to and including the 424th meeting, December 4, 1930. No printed copy could be located by the compiler of the minutes of the 306th, 307th, and 308th meetings other than brief notations in the Proceedings (vol. 19, pp. 2, 9) that given papers were presented at variously indicated meetings. The references which follow covering the period during which the minutes were published in avenues other than through the Society have been assembled in order that they may be preserved in the Proceedings, thus rendering such consecutive sequence more readily available for consultation in libraries throughout the world.

Meeting number 309, Jan. 4, 1918, Jour. Wash. Acad. of Sciences, v. 8, p. 179; 310, Feb. 7, pp. 179–180; 311, March 7, pp. 217–218; 312, Apr. 4, pp. 298–299; 313, May 2, p. 376; 314, June 6, p. 459; 315, Oct. 2, p. 610; 316, Nov. 6, pp. 663–

664, 1918; 317, Dec. 4, v. 9, pp. 22–23; 318, Jan. 8, 1919, pp. 81–82, A. B. Gahan, Recording Secretary; 319, Feb. 6, pp. 148–150; 320, March 6, p. 206; 321, April 3, pp. 357–358; 322, May 1, pp. 416–417 (duplicated in v. 10, pp. 277–278, 1920); 323, June 5, p. 420; 324, Oct. 2, v. 10, pp. 279–280, 1920; 325, Nov. 6, pp. 280-282; 326, Dec. 4, pp. 445-446; 327, Jan. 15, 1920, pp. 446–448; 328, Feb. 5, pp. 526–530; 329, March 4, v. 11, pp. 140–141, 1921; 330, Apr. 1, pp. 141-142; 331, May 6, p. 142; 332, June 4, pp. 143–146; 333, Oct. 2, p. 194–195; 334, Nov. 4, pp. 215–217; 335, Dec. 2, pp. 217–218; 336, Jan. 6, 1921, pp. 218–219; 337, Feb. 3, v. 12, pp. 163–165, 1922; 338, March 3, pp. 213–214; 339, Apr. 7, pp. 214–215; 340, May 5, pp. 215–216; 341, June 2, pp. 273–274; 342, Oct. 6, p. 274; 343, Nov. 3, pp. 319–321; 344, Dec. 1, pp. 321-322, R. A. Cushman, Recording Secretary; 345, Jan. 5, 1922, p. 335; 346, Feb. 2, p. 335; 347, March 2, pp. 335–336; 348, Apr. 6, pp. 336–340; 349, May 4, pp. 464–465; 350, June 1, pp. 465–467; 351, Oct. 5, v. 13, p. 159, 1923; 352, Nov. 2, pp. 159–160; Special Meeting, unnumbered (Dr. A. Krogh of Denmark) pp. 160–162; 353, Dec. 7, pp. 162–163; 354, Jan. 4, 1923, pp. 258–259; 355, Feb. 1, pp. 259–260; 356, March 1, pp. 260–263; 357, Apr. 5, pp. 374-375, Chas. T. Greene, Recording Secretary; 358, May 3, v. 14, p. 180, A. C. Baker, Recording Secretary, pro tem; Special meeting, unnumbered, May 23 (Bee Culture), pp. 180–181, 1924, S. A. Rohwer, Recording Secretary, pro tem; 359, Oct. 4, p. 181; 360, Nov. 1, pp. 202-204; 361, Dec. 6, v. 15, p. 79, 1925; 362, Jan. 9, 1924, pp. 79–80; 363, Feb. 7, pp. 80-81; 364, March 6, pp. 81–82; 365, Apr. 3, p. 82; 366, May 1, pp. 82–83; 367, June 5, p. 83; 368, Oct. 2, p. 83; 369, Nov. 6, pp. 136–138; 370, Dec. 4, p. 376; 371, Jan. 8, 1925, pp. 376–377; 372, Feb. 5, p. 377; 373, March 5, pp. 377-378; 374, Apr. 2, pp. 378–379; 375, May 7, p. 379; 376, June 4, v. 16, pp. 103–104, 1926; 377, Oct. 1, pp. 104–106; 378, Nov. 3, pp. 106–107; 379, Dec. 3, v. 17, pp. 172-173, 1927; 380, Jan. 7, 1926, pp. 173–174; 381, Feb. 4, p. 174, R. A. Cushman, Recording Secretary; 382, March 4, p. 174; 383, Apr. 1, pp. 175–176; Special Meeting, Apr. 20 (R. J. Tillyard of New Zealand), p. 176; 384, May 6, pp. 177–179, C. T. Greene, Recording Secretary; 385, June 3, pp. 179-180; 386, Oct. 7, pp. 180-181, T. E. Snyder, Rec. Sec., pro tem; 387, Nov. 4, pp. 181–183; 388, Dec. 2, p. 402, C. T. Greene, Recording Secretary; 389, Jan. 6, 1927, pp. 402-404; 390, Feb. 8, pp. 404-406; 391, March 3, pp. 406–408; 392, Apr. 7, pp. 431-432; 393, May 5, pp. 454-456; 394, June 2, v. 18, pp. 381–385, 1928; 395, Oct. 6, pp. 385 386; 396, Nov. 3, pp. 386-388; 397, Dec. 1, pp. 433-435; 398, Jan. 5, 1928, p. 435; 399, Feb. 2, p. 436, J. S. Wade, Recording Secretary; 400, March 1, v. 19, pp. 43 44, 1929, C. T. Greene, Rec. Sec., pro tem; 401, Apr. 5, pp. 44 45; 402, May 3, pp. 45-46; 403, June 7, p. 46; Special Meeting, Aug. 18 (Fourth International Congress delegates), p. 47; 404, Oct. 4, pp. 48 49; 405, Nov. 1, pp. 130 131; 406, Dec. 13, pp. 131–133; 407, Jan. 3, 1929, pp. 152–154; 408, Feb. 7, pp. 390 391; 409, March 7, pp. 391–392; 410, Apr. 4, pp. 392–393; 411, May 2, pp. 393 394; 412, June 6, v. 20, pp. 15–16, 1930; 413, Oct. 2, p. 114; 414, Nov. 7, pp. 114–116; 415, Dec. 5, pp. 116–117; 416, Jan. 9, 1930, pp. 153–156; 417, Feb. 6, pp. 185–190; 418, March 6, pp. 384–388, 438–440; 419, Apr. 3, 495-499; 420, Apr. 28, pp. 499–500; 421, June 5, pp. 510–512; 422, Oct. 2, v. 21, 1931, pp. 171–173; 423, Nov. 6, pp. 173–175; 424, Dec. 4, pp. 175–178, J. S. Wade, Recording Secretary; 425 et seq. published in Proc. Ent. Soc. Wash, v. 33, pp. 47–48, et seq.

Actual date of publication, April 27, 1931.

PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 33 MAY, 1931 No. 5

NOTES ON METEORUS (ZEMIOTES) NIGRICOLLIS THOMSON, AN OCCASIONAL PARASITE OF THE EUROPEAN CORN BORER.

By H. L. Parker.[1]
European Parasite Laboratory, U. S. Bureau of Entomology, Hyères, Var, France.

INTRODUCTORY.

This species was first described from Sweden. It has been taken in mugwort (*Artemisia vulgaris*) by the collectors of the European Parasite Laboratory, of the U. S. Bureau of Entomology, in northern and western France (North and South Sequanian zones and Armorican zone).

Meteorus nigricollis Thom. (Fig. 1, male), is a reddish hymenopteron about one-fourth inch long. The female, though similar to the male in other respects, has a protruding ovipositor. This species is distinguished from other braconid parasites of the corn borer, such as those of the genera Apanteles, Microgaster, Microbracon, etc., by its rather large, plump thorax, its petiolate abdomen, by the fact that it is several times as long as any one of these, and by its red coloring. It differs from *Macrocentrus gifuensis* Ashm. (the only one with which it is likely to be confused) by the fact that *M. gifuensis* is a slender, delicate, light-brown insect having an ovipositor as long as the body whereas *M. nigricollis* is stouter, of a reddish color, with the ovipositor shorter than the abdomen.

Meteorus nigricollis seems to be of no importance as a controlling factor of *Pyrausta nubilalis* Hbn. Since the first cocoon was taken in 1926, about two million larvae of *P. nubilalis* have been collected in the areas in which this parasite occurs and only 28 specimens of the Meteorus have been found.

SEASONAL HISTORY.

Little is known concerning the actual field activities of *M. nigricollis*. The cocoons have been found in the field from November to late March. It is probable that the eggs are laid

[1]The writer thanks Miss Esther Hart for her drawings of the adult and cocoon, and Dr. A. Roman and Messrs. C. F. W. Musebeck and R. A. Cushman for help concerning the identity of this insect.

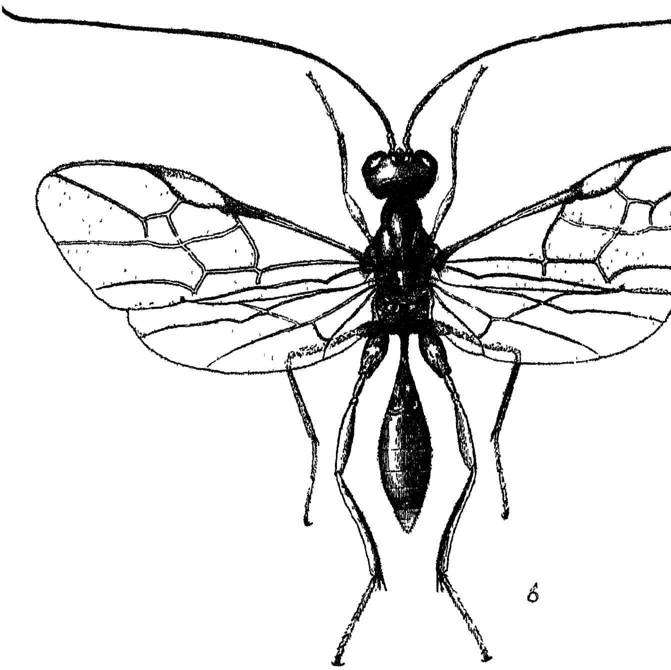


Fig. 1.

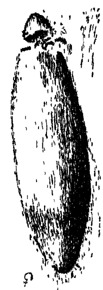


Fig. 2.

in the young host larvae in July and August, and that the larvae reach maturity and spin their cocoons in the fall, thus allowing for one generation each year. The host also has one generation per year in the above mentioned zones.

DISCOVERY AND BREEDING.

Our field collectors working in the vicinity of Tours, France, sent to the Hyères laboratory a single cocoon of this species taken from Artemisia in November, 1926. Although no host remains accompanied the cocoon, it attracted attention and was immediately placed upon the "suspicious" list. No adult issued from this cocoon. In March, 1927, another cocoon was received without host remains and no adult emerged from it. The next winter six cocoons were received from Paris, Lille, and Tours, still without host remains. No adults issued from any of these cocoons, and the writer began to despair of identifying this species. In January, February and March, 1928, several additional cocoons arrived, one of which finally produced an adult. As yet, however, there was no indication as to the identity of the host. The writer was unable to prevail upon the

field collectors to procure the host remains with these cocoons. In the winter of 1928–29, one female, emerging in the laboratory on February 14, lived for 47 days and paid some attention to larvae of *P. nubilalis*, although she died without ovipositing. Finally, by offering pecuniary rewards, the writer obtained, in January, 1930, a cocoon accompanied by the host remains which was identified as a *P. nubilalis* larval skin. At about the same time two males and a female issued in the laboratory from cocoons collected on November 20.

The female just mentioned was given sugar water for food, and after a day's separation the males were placed with her. The males seemed to be sexually active at once. They started the usual "courtship" process peculiar to the parasitic Hymenoptera, i. e., fanning the female by rapid vibrations of the wings, at the same time bringing the body to an almost vertical position. They were allowed to remain with her until the next day and were then removed. Actual copulation was not observed because the female seemed to move around too rapidly. It is probable, however, that mating took place, as a female was later found among the offspring.

After seven days of feeding, a third-stage *P. nubilalis* larva was given to the female parasite upon a bit of leaf where she had been feeding. This attracted her attention and she immediately deposited an egg in it. About a dozen other small larvae were stung and then, the supply being exhausted, fully grown overwintering host larvae were offered to her. To the surprise of the observers she stung these as well. During the next seven days (March 1–7) forty-nine larvae were stung by this individual, 34 of which bore one egg each, and one of which, owing to long exposure, bore two.

This female died on March 7, after having lived 20 days.

Another female, which emerged in the laboratory on April 6, lived 29 days but laid only 3 eggs.

OVIPOSITION.

The act of oviposition is quite different from what might be expected of a rather nervous, fast moving insect.[1] Upon perceiving a host larva, the female immediately becomes still, and fixes her attention upon it as if "stalking" the prey. She moves towards the latter, evidently further excited or "inspired" by its slight movements, for when the host remains motionless no oviposition takes place. As she approaches the host the abdomen is brought forward under the thorax, the ovipositor pointing horizontally forward is apparently fondled by the mouthparts for an instant and then, guided continually by the sheaths,

[1]The act of oviposition in *M. versicolor* Wesm. is similar, according to Muesebeck (Jour. Agr. Research, Vol. XIV, No. 5, 1918, p. 201.)

it is slowly thrust forward much in advance of the female's head until the point touches the host. It is evidently inserted slowly and painlessly, as the host generally makes no movement during the insertion. After the egg is laid, however, the host seems to be aware of the withdrawal of the sting, for it gives a sudden lunge as if to free itself from this contact. After pulling the ovipositor out of the host, the female slowly straightens out her abdomen and moves away, apparently not anxious to continue. Oviposition therefore seems to be, at least in captivity, with *P. nubilalis* for host, a series of complete incidents each exactly similar in cause, execution and effect to the one immediately preceding it, and not, as is the case with certain other parasitic species such as the Campoplegines, a definite and prolonged searching for hosts with apparently no other preoccupation than to deposit an egg.

HATCHING, FEEDING AND GROWTH.

The parasitized larvae were isolated in vials at 20°C. and given the necessary care. Frequent dissections were made to observe the progress of development.

After 24 hours, the eggs were found to be in the blastula (Fig. 4) stage, the pedicel being practically empty; after four days, the embryo was formed, the egg being greatly enlarged and the chorion lined inside by a serosal membrane composed of more or less hexagonal cells containing rather large nuclei (Fig. 6). On the fifth day some larvae were hatched and others were still within the egg (Fig. 5) but turning and twisting, apparently scraping the walls of the egg with the mandibles and pushing with the tail in an effort to break out. When the larva finally breaks out it leaves the sack-like egg shell containing the serosal membrane floating free in the body cavity. Other eggs laid in full-grown host larvae hatched in seven days under the same conditions.

After ten days a larva was found to be still in the first stage with the mid-gut somewhat distended by a yellowish substance. At this point it was noted that the fat of the host was discolored (being slightly gray to violet) in spots and somewhat hardened. On the seventeenth day in one case, and on the eighteenth in another, parasite larvae were observed to be in the second stage with the skin of the first stage about half off the body. At this point the serosal membrane had become dissociated into isolated cells, which had floated out of the bag-like eggshell and, having increased in size, had become quite conspicuous in the blood of the host as large, round or oval cells with big nuclei.

No further observations were made until the twenty-first day after deposition, when the first cocoon was spun. Upon opening another host a last (probably third) stage larva was found.

At the same time it was noticed that nearly all the hosts were considerably discolored. Externally they were of a dirty brownish color. Internally the fat body, bearing apparent wounds in many places, was of a grayish violet color, while in the center of each "wound" were two small dark spots, probably the wounds made by the mandibles of the feeding first or third stage larva, as it holds with these appendages to the fat body in order to suck out the fat. In addition the pericardial cells were strongly stained, being a rusty brown color and standing out most distinctly against the whitish muscles.

In the case of *Eulimneria crassifemur* Thoms., an ichneumonid parasite of *P. nubilalis*, it has been noted in an earlier publication[1] that where several eggs are laid in one host, only one larva lives and the others die. It was further pointed out that the death of the supernumerary larvae was probably not due entirely to combats between them, but that there was reason to suppose that the earliest feeding larva poured some substance, perhaps a cytolytic enzyme, into the host's blood, thus causing the death of the younger larvae or eggs. Paillot,[2] without giving any further hypothesis on the subject, says that this is not so. It would seem to the writer, from these observations on Meteorus, that the feeding parasite does pour some substance into the blood of the host and that this substance, whatever it be, discolors the fat, and as the host larva tries to purify its blood by excretory activities the pericardial cells become highly colored with it. It must be pointed out that occasionally, though very rarely, the discolored condition of the pericardial cells will be observed in *apparently* unparasitized larvae from the field. Whereas in the writer's experiments every larva bearing a parasite was so discolored, the discoloration of the fat in the manner hereinbefore described has never been seen in unparasitized larvae.

It may be pointed out in this connection that Balduf[3] states that when an egg of the parasite of *Dinocampus coccinellae* Schrank is laid in a host coccinellid which is already occupied by a well-established larva of the same species, the larva hatching from the last egg does not live longer than the first instar.

In addition to the state of affairs previously described, the body cavity of a *P. nubilalis* larva contains a great quantity of the Meteorus serosal cells, now much larger than they were when observed on the seventeenth day. These cells, whose structure is

[1]Thompson, W. R., and H. L. Parker. U. S. Dept. Agr. Tech. Bul. No. 58, 1928.

[2]Paillot, A. In International Corn Borer Investigations, Scientific Reports, Vol. 1, 1928, Chicago.

[3]Balduf., W. V., Ann. Ent. Soc. America, Vol. XIX, 1926, p. 478.

shown in Fig. 7, are spherical in form and are lodged singly and in groups among the organs and tissues of the host. It is not known whether or not these cells reproduce by division. None were seen dividing in the sectioned material. It is apparent, however, that they have the power of growth by the absorption of materials from the host's blood. In this respect they are comparable to the trophamnios in certain Platygasters and other parasitic Hymenoptera, some of which reproduce by polyembryony. They also resemble in general structure the pseudogerms or trophamniotic fragments of *Macrocentrus gifuensis*, a polyembryonic braconid.

In résumé, the time required for the development of this species at 20°C. is about as follows:

From egg to first stage	5– 7 days.
From egg to second stage	17–18 days.
From egg to cocoon	24 days.
From cocoon to adult	21 days.
Average time for development	45 days.

After the completion of internal feeding the parasite larva pierces the host skin and works its way out, leaving the host carcass about half empty. This carcass invariably turns black. The parasite larva sometimes constructs its cocoon near the old host skin, but more often it moves away a short distance before spinning. The cocoon is completed in about twenty-four hours.

Generally, Meteorus cocoons are suspended from the leaves or twigs by a short thread. Such is not the case with this species, however, as they are spun in the tunnel of the host larva.

Several days after spinning, the blackish larval meconium is cast within the cocoon, the insect pupates, and after about twenty-one days (15 days at 25°C.) the adult chews off a small cap at the more sharply pointed end of the cocoon, and emerges. Fig. 2.

In the material considered in this work there were 16 individuals for which it was possible to determine the sex, 15 males and 1 female, of which 3 males reached the adult stage and 12 were determined from larvae in the second or third stage.

DESCRIPTIONS OF IMMATURE STAGES.[1]

Egg (Plate 2, Fig. 3).—Length 0.47 mm., width 0.079 mm., club-shaped, arched, translucent, whitish, without spines or tubercles.

[1]As the internal anatomy of the larva of *Meteorus nigricollis* is similar to that of many other braconid larvae described elsewhere, the writer considers it sufficient for this paper to describe and illustrate the larval organs in *grosso modo*.

First stage larva[1] (Fig. 8).—Length 1.3 mm., composed of a broad, heavily chitinized, dark head capsule (Fig. 10, followed by nine more or less equal, cylindrical body segments and a tenth which is prolonged into a pointed tail slightly more than half as long as the first nine segments together. A pair of sharp, curved mandibles (Fig. 9) and a pair of inconspicuous labral papillae are present (Fig. 10 *lbrp*). The tracheal system is composed of a longitudinal trunk on each side of the body, connected anteriorly by a dorsal commissure; a branch extends into the head from each trunk. There are no ventral commissures, spiracles, or segmental branches. There are no spines or setae on the cuticle.

Second stage larva (Fig. 11).—Length 4 mm. The larva of this stage has changed considerably in appearance from that of the earlier stage. It has a more or less hemispherical head, whitish like the rest of the body, and ten more or less equal body-segments, the last of which is very slightly pointed ventrally to the anal opening. The mandibles are not apparent or are not at all chitinized. The mouthparts are, however, differentiated into labrum, maxillae, and labium. The body, owing to the presence of large lobes on each segment, is not cylindrical but appears somewhat flattened dorsoventrally; there are no spines on the cuticle. The internal organs are easily visible; the mid-gut, filled with a yellowish creamy substance, is distinctly separated from the hind-gut by a short constriction; the salivary glands (Fig. 11, *sg*) consist of two long, tortuous tubes on each side of the mid-gut extending almost its entire length; the Malpighian tubes (Fig. 11, *mt*) are two thin wavy tubes lying ventrally, one on each side of the nerve chain, and extending from the hind-gut forward to the second abdominal segment; the fat body consists of a thin layer of small cells between the mid-gut and the muscles and between these and the hypodermis, a few tiny white urate cells can be seen distributed among the fat cells; the tracheal system is similar to that of the first stage, except that there is now a dorsal and a ventral branch in each segment; the integumental muscular system (Fig. 12), the reproductive gonads, imaginal discs, and heart are of the usual braconid types.

Third stage larva (Fig. 13).—Length 5 mm. Subcylindrical, slightly flattened and arched dorsoventrally; tapering slightly at both ends, composed of head and thirteen segments; color grayish white.

The head (Fig. 14) is almost hemispherical, bearing dorsally two rather large round spots in the center of which is a sensory papilla representing the antennal rudiments (Fig. 14, *ant*); the mouthparts are somewhat more distinctly delineated than in previous stages, having the labrum, maxillae, and labium separated by brownish sutures; the mandibles are again apparent (Fig. 14, *md*), and various sensory papillae are present on the labrum, maxillae, and labium; the head is covered with small rugosities, and underneath the labium there are many tiny cuticular spines and tubercles.

[1]Other meteorus larvae of the first stage have been described by Muesebeck (Jour. Agr. Research XIV, No. 5, p. 202. 1918) and Strickland (Dom. Canada Dept. Agr. Bul. 26, N. S., p. 6, 1923), and they are similar to that of *M. nigricollis*.

Silvestri (Bol. del Lab. di Zool. Gen. e Agr. XVI, p. 241. 1922. Portici) figures a larva somewhat similar in outline to that of *M. nigricollis* and supposes it to be that of *Meteorus cinctellus* Nees. From a study of the head characters it seems certain that this larva is an ichneumonid.

GENERAL ANATOMY.

The body is almost entirely covered by tiny cuticular spines, except for the intersegmental lines and small areas around the spiracles; small hardened discs are present externally opposite the imaginal buds of the legs, wings, and external reproductive organs.

The internal anatomy is very similar to that of the second stage. The mid-intestine is full of food material and occupies the greater part of the body cavity; it does not communicate with the hind-gut, which is a short flask-shaped organ in the extreme posterior end of the larva; the salivary glands and Malpighian tubes are somewhat thicker than in the second stage but retain the same general form and disposition; there are only a few dozen urate cells and they are very small; the tracheal system is similar to that of the second stage except that there are nine pairs of spiracles open on segments II and IV to XI, and the segmental branches are much ramified; the ventral branch divides shortly after leaving the lateral trunk into two almost parallel branches extending ventrally along or near the anterior intersegmental line. There is a stub of a spiracular branch in segment III, but no spiracle; there are no ventral commissures, not even posteriorly, as is the case with certain other braconids such as Macrocentrus, Microbracon, etc.

LIMITING FACTORS.

Our knowledge concerning *M. nigricollis* is extremely limited. Few observations have been made upon its activities in the field, and the number and variety of its hosts are unknown to us.

It would seem logical, in view of the fact that the females show a certain reluctance to oviposit in *P. nubilalis* larvae, to conclude that this species is not the usual host of *M. nigricollis*. The scarcity of this insect as a parasite of *P. nubilalis* would further warrant such a conclusion.

It is noted in this connection that the corn borer is an *efficient* host for this species in the sense that when eggs are deposited in it they hatch and grow to maturity easily. In 25 cases upon which it was possible to make observations, only one egg died within the host while 24 hatched. Ten of these were later killed for study and fourteen reached the fully grown larval stage. It can not therefore be maintained that *M. nigricollis* is not "adapted" to live in the larva of *P. nubilalis*.

If, however, *P. nubilalis* is the principal host of *M. nigricollis*, then it is not improbable that its scarcity can be accounted for, at least partially, by a certain inherent weakness in this species. In any case the remarks that follow would apply to *M. nigricollis as a parasite of P. nubilalis.*

Before going into the explanation of the above-mentioned "inherent weakness" in this species it is well to summarize the data upon the fate of the eggs laid in the laboratory:

35 eggs were laid; 1 egg was found dead in host larva; 16 eggs and young larvae were fixed for study; 3 last-stage larvae issued from host larvae and were fixed for study; 11 larvae issued from host and died without properly defecating; 11 individuals spun cocoons completely; 1 died in cocoon after defecation; 3 individuals issued as adults.

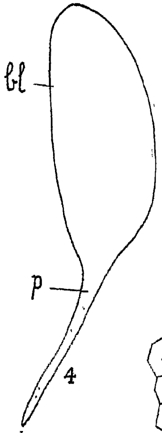
The large proportion of larvae dying in the fully grown stage can be accounted for by their failure to defecate properly. This is the constitutional weakness referred to above. As is well known, in the parasitic Hymenoptera there is no communication between the mid-intestine and hind-intestine until just about pupation time, when the wall separating the two is broken down and all the accumulated materials are then voided simultaneously. These eleven larvae of *M. nigricollis* were unable to break down this wall and expel their feces.

Examination of the larvae showed that metamorphosis was well under way. The histoblasts of the antennae, legs, wings, and external reproductive organs were greatly lengthened and developed to the point where they bore a resemblance to the corresponding imaginal organs; the wall of the adult intestine was being formed and the larval wall was seen to be shedding its old cells to the interior. The junction between the mid-intestine and hind intestine was blocked by a bunch of these old cells, some of which had been forced out into the anterior part of the hind-intestine.

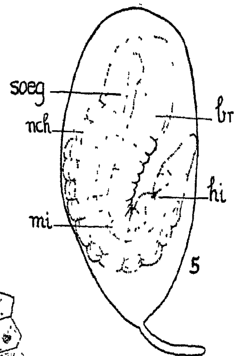
The general appearance of a larva in the above condition is a somewhat unhealthy yellowish color, against which the dark contents of the mid-intestine show prominently. Some desultory spinning is done by larvae in this condition, movements become slower, and in about 30 to 40 days after emergence from the host the larva is dead or dying.

These observations probably shed some light upon the failure to procure adults from a number of cocoons received in the laboratory, as set forth in the earlier part of this paper, and seem to the writer to be the most plausible explanation for its scarcity as a parasite of *P. nubilalis*.

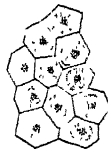
3



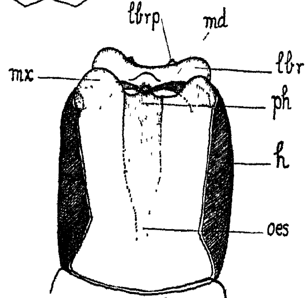
4



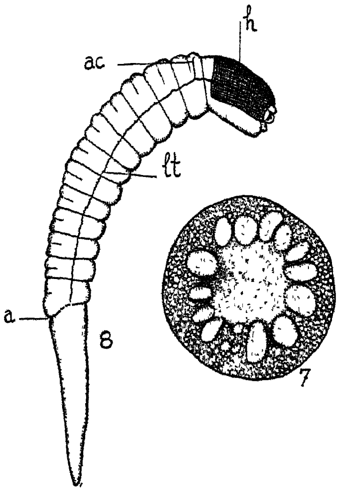
5



6

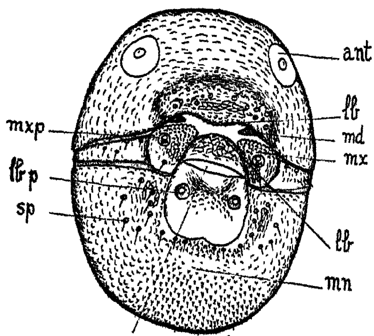


10

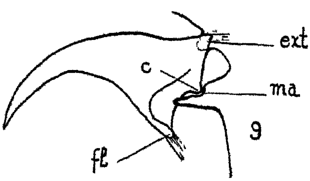


8

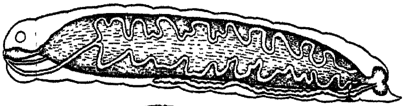
7

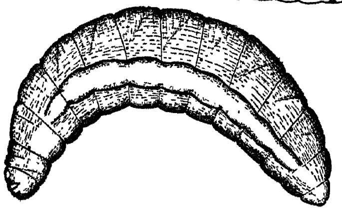


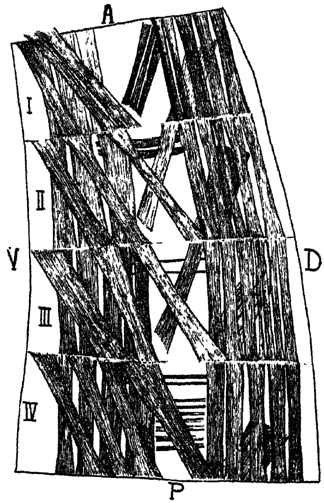
14



9

1


3




12

EXPLANATION OF PLATE 2.

Fig. 3. Newly laid egg.
Fig. 4. Egg in blastula stage.
Fig. 5. Larva about to hatch, same scale as figs. 3 and 4.
Fig. 6. Aspect of the serosal membrane.
Fig. 7. Serosal cell after hatching of larva, enlarged.
Fig. 8. First-stage larva.
Fig. 9. Mandibles of first-stage larva.
Fig. 10. Head of first-stage larva.
Fig. 11. Second-stage larva.
Fig. 12. Integumental muscles of Segments I–IV of larva.
Fig. 13. Last-stage larva.
Fig. 14. Head of last-stage larva.

THE LARVA OF BOROS UNICOLOR SAY AND THE SYSTEMATIC POSITION OF THE FAMILY BORIDAE HERBST.

BY R. A. ST. GEORGE, *Bureau of Entomology, U. S. Department of Agriculture.*

INTRODUCTION.

The larva of *Boros unicolor* Say is one of numerous species that were collected by Dr. F. C. Craighead and the writer from beneath the bark of several dead shortleaf pine trees in the Pisgah National Forest, near Asheville, North Carolina, in August, 1926.

At the time infested sections of wood containing larvae were caged out of doors. In June, 1927, when the writer next visited

the locality, the larvae had transformed to imagines. A series of reared specimens were determined by W. S. Fisher, of the division of taxonomy and interrelations of insects, U. S. Bureau of Entomology, as *Boros unicolor* Say.

Subsequent collections of larval material by the writer revealed that *Boros* attacks pine trees within two to three months after the death of the trees and continues to infest them for a period of over three or four years. There is apparently only one generation a year. Trees are selected that have retained some of their moisture; and because those killed by the southern pine beetle dry rapidly near the top, most of the *Boros* larvae are usually concentrated in the lower portion of the trunk where more moisture is present.

The larvae probably feed upon decaying vegetable matter that is found beneath the bark of the trees. Many larvae of various sizes have been found together in the same tree, indicating that repeated infestation occurs over a long period of time.

Leonard (*8*)[1] states that adult beetles of *Boros unicolor* have been taken in New York State in the months of February, March, April, and November, and Blatchley (*1*) records one specimen which was removed from beneath the bark of pine in Indiana in October.

DESCRIPTION OF THE MATURE LARVA OF BOROS UNICOLOR SAY.

Length, 27 mm.; color testaceous, with head, thorax and eighth and ninth abdominal segments darker; mandibles, antennae, tips of claws, and ninth abdominal segment piceous; anterior and posterior margins of prothorax, and posterior margins of the following ten segments longitudinally, very finely striated; tergal shields of all thoracic and of the first eight abdominal segments with a light median longitudinal suture; anterior portion of tergal shields of mesothoracic and all of the following eleven segments smooth, shining, and ornated with a transverse, somewhat curved, medianly obliterated, linear depression with a raised anterior margin. Larva elongate, with sub-parallel sides, decidedly depressed, about nine times as long as wide (Plate 3, fig. 7); ninth abdominal segment movable up and down, plate-like, with falcate, slightly incurved urogomphi. Head, thorax, and abdomen sparsely furnished with setae, present mostly on the lateral and posterior margins of thorax and abdomen.

Cranium rounded (Plate 3, figs. 1 and 2), nutant, exserted, about two-thirds as long as wide (from posterior margin of labrum (*lab*) to the occipital foramen), broadest medianly, sharply curved posteriorly, dorsally and ventrally more or less flattened; a few reddish setae present.

Frons (*f*) fused with clypeus (*cl*), together constituting five-sixths of length of cranium; limited by a lyriform frontal suture; on each side with one seta in the margin immediately behind labrum, one near base of antenna, and one near each of the tentorial pits (*tp*).

[1]Numbers in parenthesis refer to literature cited.

Epicranial halves separated dorsally by a short epicranial suture and ventrally by the gula (*gu*) plus the posterior part of the submentum (*sm*); each epicranial half dorsally with one seta near basal membrane of antenna, one seta in the ocellar group, one seta near the frontal suture between tentorial pit and anterior end of epicranial suture, and several minute setae near occipital foramen; ventrally on each side with one long seta near anterior margin of basal membrane of antenna, one long seta near end of hypostomal margin, and one long seta at margin of ocellar group; side margins of head posteriorly with one small seta.

Gula (Plate 3, fig. 1, *gu*) distinct, subtrapezoidal, wider than long, widest posteriorly, with a small sclerotized plate in the center, and with membranous margins laterally.

Labrum (figs. 2 and 10, *lab*) testaceous; movable; well developed, transversely subrectangular, one-third wider than long, anterior margin slightly convex, anterior corners rounded; disc between center and lateral margins with one long seta on each side, and more laterally with one short seta near the margin; along anterior margin with four dorsally placed setae on each side, and with four rather short and slightly curved setae ventrally on each side (Pl. 4, fig. 11).

Ocelli contiguous to basal membrane of antenna; distinct; five on each side of head, arranged in two groups; three in an anterior and two in a posterior group (Pl. 3, fig. 2).

Antenna attached to a distinctly colored rim immediately behind the dorsal mandibular fossa (Pl. 3, fig. 1); basal antennal membrane (fig. 2, *bm*) well developed; three antennal articles present, all ferrugineo-testaceous; anterior portion of each article rather membranous; basal article subcylindrical, about three times as long as wide, and about one-fourth longer than the second article; second article apically on ventro-lateral side, bearing a minute supplementary appendix beside the apical article; apical article cylindrical and only about one-half as long as the second one; all three articles with numerous minute setae along the sides and, in addition, with a transverse series apically placed along the edge of the membranous portion.

Mandibles dark; slightly asymmetrical; both apically trifid (Pl. 3, figs. 3 and 4, a^1, a^2, a^3), each with two additional teeth along the cutting edge between apex and molar part (*m*); molar part of left mandible anteriorly with a strong conical projection (fig. 4, *m*); molar part of right mandible (fig. 3, *m*), with a similar but smaller and more flattened projection; grinding surfaces of both mandibles facing each other, and both slightly carinate; cutting edge on ventral surface slightly excavate; molar portion of right mandible, in addition to the described grinding surface, with faint asperities on the ventral side (only seen with the aid of the compound microscope); back of mandible rounded opposite the cutting edge and the molar part, and bearing one seta anteriorly and one posteriorly.

Maxilla dorsally almost completely covered by the mandible (Pl. 3, figs. 1 and 6); quite well sclerotized except apically where rather membranous along the outer margin; palpiger (*pag*) small, indistinctly separated from stipes (*sti*), and rather membranous; near its exterior margin with a seta; palpus (fig. 6, *mxp*) surmounting mala by about one-third of its own length; with three articles, all testaceous, anterior portions rather membranous; basal article clavate, about one-third of the entire length of palpus, nearly as long as wide, near apex on outer side with two small setae; second article subcylindrical, slightly wider

than long, apically with one or two setae; distal article slightly conical, longer than wide, about twice as long as distal article of labial palpus, with soft tip bearing several tactile hairs.

Mala testaceous; fused with stipes; obtuse, with slight terminal incision near the inner margin (Pl 3, fig. 6, *ma*); dorsally in the anterior part of the inner margin with a continuous series of well developed, somewhat curved, strong setae, rest of the dorsal surface without setae; ventrally in anterior part of inner margin with several spine-like setae, especially strong and more or less amalgamated at the corner-projection of the mala; in addition with one long seta along median portion of exterior margin near anterior portion of palpiger.

Stipes (figs. 1 and 6, *sti*) well sclerotized, slightly darker along exterior margin; two well developed setae present on ventral side, one near the middle of the interior, and one near the middle of the exterior margin; in addition with one small seta on the dorsal side near the middle of the exterior margin.

Cardo (*ca*) well sclerotized, subrectangular, slightly longer than maxillary palpus, divided into two parts, disti-cardo anteriorly and proxi-cardo posteriorly; inner margin of disti-cardo adjacent to the maxillary articulating area (*mar*).

Maxillary articulating area (*mar*) slightly protuberant, membranous, indistinctly divided into three parts.

Submentum (fig. 1, *sm*) well sclerotized, trapezoidal, broadest posteriorly; side margins slightly concave and adjacent to the maxillary articulating area anteriorly, convex posteriorly; on each side bearing one long seta near end of transverse middle line.

Mentum (fig. 1, *me*) lightly sclerotized, particularly in the posterior half; slightly wider than long, cup-shaped, side margins free; on each side of posterior half with one short seta.

Prementum fig. 1, *pm*) lightly sclerotized, indistinctly separated from ligula (*li*); without setae.

Labial palpus (*lp*) about half as long as maxillary palpus; with two articles; each article testaceous, with the anterior portion rather membranous; palpifer (*paf*) indistinctly separated from the rest of the premental area (*pm*), apically on inner margin bearing a single seta; basal article of palpus cylindrical, about twice as wide as long; apical article conical, slightly longer than wide, apically with soft tip bearing minute tactile hairs.

Ligula (Pl. 3, fig. 1, *li*) slightly testaceous, broadly conical, as wide as long, on each side with about three setae and many tactile hairs along the margin and on the buccal surface (Pl. 4, fig. 16, *li*).

Prehypopharynx (fig. 16, *prh*) simple; membranous, with side margins slightly sclerotized posteriorly; whole surface covered with tactile hairs (which can be seen only with aid of compound microscope).

Posthypopharynx (*poh*) composed of median anterior area, a median posterior hypopharyngeal chitinization, and a pair of postero-lateral areas. Median anterior area (fig. 16, *mea*) membranous and without tactile hairs. Median posterior sclerome (fig. 16, *hsc*) not projecting, transverse, supported by sclerotized rods. Paired postero-lateral areas generally membranous, slightly sclerotized posteriorly.

Epipharynx (Pl. 4, fig. 11, *eph*) soft skinned, with heavily sclerotized side

margins and with a posterior, transverse, broad sinuous, sclerotized band (*tb*); with two elongate patches of minute teeth (t^1) extending posteriorly from the middle of the sclerotized band toward oesophagus; immediately behind the teeth with eight sensory punctures (so^2), in front of the teeth (t^1) with two tiny sclerotized hooks (*h*), and immediately in front of the hooks with eight more sensory punctures (*so*); rest of epipharynx beset with tactile hairs.

Legs inserted widely apart; well developed and all of about the same size; each leg consisting of five articles, tarsus and claw fused into a tarsungulus (Pl. 4, fig. 13 and pl. 3, fig. 5). Coxa (Fig. 13, *cox*) somewhat membranous, subrectangular, wider than long, bearing a few short setae; trochanter (*tr*) slightly testaceous, about one-fourth longer than wide, with a few moderately long or short setae; femur (*fe*) testaceous, with posterior face slightly darker, about one-fifth longer than wide, sparsely armed with setae, one of which is much longer than the rest; tibia (*ti*) testaceous, twice as long as wide, with some short and fine setae all over, and distally with a few long setae; tarsungulus (*ta*) strong, with a broad, testaceous basal part and a falcate, piceous tip, two setae present near base.

Prothorax subquadrate, about one and one-half times as long as head (Pl. 3, fig. 7). Prothoracic presternum (Pl. 3, fig. 5) lightly sclerotized, very large and divided into two subtriangular lateral parts (y^1) and a subspatulate median part (y^2); each lateral part with one anterior and one posterior minute seta, median part without setae. Eusternum (*eu*) and sternellum (*stl*) rather membranous; eusternum situated in front of the legs, sternellum behind them; eusternum apparently separated into two parts by posterior end of presternum; sternellum unpaired, transverse; eusternum without setae, sternellum with one pair of minute setae. Poststernellum (*z*) lightly sclerotized, large, subtriangular, widest anteriorly. Prehypopleural and posthypopleural areas (h^1 and h^2) both present, very lightly sclerotized; prehypopleural area particularly well developed and internally adjacent to the presternal area; each prehypopleural area with a minute seta; the posthypopleural areas without setae. Epipleurum consisting of a small pre-epipleurum (ep^1), internally adjacent to the presternal and prehypopleural areas, an elongate narrow medio-epipleurum (*ep*) and a small, triangular post-epipleurum (ep^2). Prothoracic tergal shield (Pl. 3, fig. 7) subquadrate; in each anterior corner bearing two setae, and posteriorly near median suture a single, minute seta.

Mesothorax and metathorax subrectangular, somewhat wider than long, not fully as long as prothorax. Presternal areas (*y*) of both segments paired, small, subtriangular, and separated by the poststernellum of the preceding segment; each presternal area with two minute setae. Eusternum of both segments (Pl. 3, fig. 5, *eu*) indistinctly separated from sternellum (*stl*), testaceous, subquadrate; with two small setae anteriorly and one posteriorly. Sternellum (*stl*) subquadrate; one seta medianly on each side. Poststernellum (*z*) of mesothorax subrectangular, transverse, with one seta medianly on each side; poststernellum of metathorax absent. Prehypopleurum (h^1) well developed, with a small sclerome near the condyle for the articulation of the leg; posthypopleurum (h^2) present. Pre-epipleural area of mesothorax (ep^1) with a large spiracle facing dorso-laterally, pre-epipleurum of metathorax with a vestigial spiracle; two minute setae present on each area; medio-epipleural (*ep*) and post-epipleural

(ep^2) areas about as in the prothoracic segment. Mesothoracic and metathoracic tergal shields (fig. 7) sclerotized, subrectangular, only slightly wider than long; mesothoracic shield with a small thickening anteriorly in the middle, both shields with a transverse linear elevation inside of and parallel with the front margin; terga of both thoracic segments with the setae arranged as in the prothorax.

First seven abdominal segments built alike, all transversely subrectangular. Sternal areas almost fused and rather well sclerotized; hypopleural and epipleural areas rather membranous, longitudinal and narrow; tergal areas (Pl. 3, fig. 7 and Pl. 4, fig. 12, *ter*) covered by a transversely rectangular shield, anteriorly marked by a medianly broken, transverse, linear impression extending from near the median suture to the lateral edge of the shield, passing in front of the spiracle where the impression is somewhat indistinct; shield marked posteriorly along the lateral margin by a longitudinal impression extending the length of the segment. Setae of the first seven abdominal segments arranged alike. On each side of sternum only one seta, placed postero-laterally (Pl. 4, fig. 12, *ster*); hypopleurum with a few minute setae in an anterior transverse series and a few minute ones in a posterior transverse series (fig. 12, *hp*); epipleurum (*ep*) without setae; tergum (*ter*) with one seta in front of spiracle below the longitudinal impression and in front of the faint lateral end of the transverse impression, one seta posteriorly below the longitudinal impression, one seta antero-medianly behind the spiracle and above the longitudinal impression, two setae posteriorly, close together, just above the longitudinal impression, and one seta paramedian, close to the posterior margin of the shield.

Eighth abdominal segment longer than any of the first seven abdominal segments and twice as long as the subsequent ninth, excluding the urogomphi. Sternal area of eighth abdominal segment, rather well sclerotized, elongate and narrow (Pl. 3, fig. 8, *ster*), hyplopleural (*hy*) and epipleural (*ep*) areas slightly sclerotized, hypopleurum wider than in the preceding segments; tergal area covered with a shield, marked on each side with an anteriorly convex, transverse impression and with a straight longitudinal impression. Sternum without setae; hypopleurum with four small setae along the posterior margin; and two along the inner margin; epipleurum and tergum with setae as in the preceding segments.

Ninth abdominal segment smaller than eighth; movable in directions up and down. Venter of segment consisting of an anterior and a posterior part; anterior part membranous, with a series of small plates on both sides of the tenth segment; posterior part large, subtriangular, heavily sclerotized, and divided longitudinally by a median suture (Pl. 3, fig. 8, *IX* and *X*). A posteriorly somewhat projecting and hook-shaped pair of the small plates present nearest to the tenth segment and surrounding it, possibly supporting the body when the posterior large plate is moved upward; also a sclerotized, posteriorly directed pit present at the base of each urogomphus. Tergum of segment one-half the length of the eighth abdominal tergum, plate-like, heavily sclerotized with the exception of a median longitudinal suture and a small anterior membranous portion connecting it with the shield of the eighth abdominal segment; anteriorly with a lobe-like projection on the lateral margin; posteriorly projecting into a falcate urogomphus, curving inwards; between urogomphi an unpaired

median subtriangular projection (figs. 7 and 8). One seta present on the small plate surrounding the tenth segment, rest of small plates without setae; large posterior ventral plate with a small seta medianly on each side; lobe-like projection of tergum with one long and one short seta (fig. 7); each urogomphus with one long seta near base on inner margin, two long setae dorsally and two more ventrally near the tip, and several soft hairs along inner margin.

Tenth abdominal segment (Pl. 3, fig. 8, *X*) ventral, membranous, trilobed. Area surrounding lips covered with minute setulae.

Spiracles (Pl. 3, fig. 9) annular, with oval mouthpiece, transversely directed, cup-shaped, sides provided with minute tubercles, at bottom with a linear opening. Thoracic spiracles located dorso-laterally in the pre-epipleura; the mesothoracic ones large, the metathoracic vestigial. Abdominal spiracles dorso-laterally placed in the tergal shields immediately behind and below the point of intersection between the transverse and longitudinal linear impressions of the shield.

COMMENTS.

The genus *Boros*, of which *Boros unicolor* is the only American species, is rather aberrant both in the imaginal and larval stages.

Based on the characters of the imagines this small unit has been classified very differently from time to time. In 1797 Herbst (*4*) created the genus, called it *Boros* and gave his type specimen the specific name *elongatus*, but in so doing overlooked the fact that Panzer (*11*), in 1796, already had given it the specific name *schneideri*. Thus his new specific name became a synonym. In 1827 Say (*13*) described the North American species *Boros unicolor* and in part commented as follows: "I received this insect from Dr. J. F. Melsheimer under the name I have adopted. It is certainly very closely allied to *B. elongatus* Herbst." In 1872 Motschulsky (*9*) described another species, *Borocus*[1] (= *Boros*) *sibericus* from Siberia. In 1854 Mulsant (*10*) included *Boros* in the Tenebrionidae ("Tenebrionides") between *Bius* and *Calcar*, and in 1858 Redtenbacher (*12*) likewise placed this form near the position assigned to it by Mulsant. In 1859 Thomson (*15*) made the genus *Boros* the type of a new family, Boridae, and placed this between the Tenebrionidae and the Alleculidae (Cistelidae). However, at the suggestion of LeConte (*6*) he later changed its systematic position to near the families Salpingidae and Pythoridae in his "Phalanx II." LeConte, in 1862, regarded *Boros* as a genus of the family Pythidae, tribe Pythini, and placed it just before the genera *Crymodes*, *Pytho*, and *Priognathus*. Since then it has been included as a genus either in the Pythidae or in the Tenebrionidae. Henshaw (*3*) and Blatchley (*1*) have it in the Pythidae, Gebien (*2*) and Leng (*7*) in the Tenebrionidae, subfamily Tenebrioninae. Kiesenwetter and Seidlitz (*5*) noted that *Boros* did not conform to the rest of the Tenebrionidae.

[1]*Borocus*, a new name, is apparently a lapsus for *Borus* since Motschulsky does not include the name in his key to genera in the preceding pages.

The larva of *Boros unicolor* shows definitely that the genus can not be placed in the Tenebrionidae. The larvae of the Tenebrionidae, whose taxonomic relationship was first treated by Schiödte (*14*), are defined by the following family characters: Body never depressed, prothoracic coxae with apices contiguous (except in a few genera), clypeus and labrum distinct (Pl. 5, figs. 14 and 17), cardo simple (Pl. 5, fig. 15, *ca*), and sternum of the ninth abdominal segment without a series of asperities or of sclerotized plates. None of these characters are common to *Boros*, as is evident from the above-given description of the larva of *Boros unicolor*.

To the larvae of the Pythidae, however, the larva of *Boros* is very closely related, and also to the larvae of the Pyrochroidae and Othniidae. Like the larvae of all of these three families it has a very depressed body, the prothoracic coxae are widely separated, the clypeus is fused with the frons, and the cardo is divided into two parts (Pl. 3, figs. 1 and 6).

The mandible of *Boros*, which has a trifid apex, a cutting edge bearing two additional teeth, and a mola with carinate surface, likewise indicates close relationship to all of the three mentioned families, but particularly to the Pythidae and Pyrochroidae, because the larvae of the Othniidae possess teeth on the grinding surface of the mola, which is not the case in the Pythidae (fig. 19) and the Pyrochroidae. The hypopharynx of *Boros* resembles in general that of all of the three families, but is most nearly built as in the Othniidae. The epipharynx of *Boros* (fig. 11), on the other hand, is more similar to the epipharynx of the Pyrochroidae than to the epipharynges of the other two families. Also in regard to the structure of the eighth and ninth abdominal segments *Boros* resembles the Pyrochroidae mostly; both in *Boros* and in the Pyrochroidae the tergum of the eighth abdominal segment is about twice as long as that of the ninth (urogomphi not included), and there is a pair of pits in the margin between the bases of the urogomphi; in the Pythidae and the Othniidae, on the other hand, the eighth and ninth abdominal terga are subequal in length and only one pit is present in the margin between the bases of the urogomphi. In a very essential character *Boros* differs from the Pyrochroidae, the ninth abdominal sternum being provided with a row of sclerotized plates in *Boros* (fig. 8) but with a row of asperities, arranged in a continuous arch, in the Pyrochroidae (Pl. 4, fig. 23).

Considering the above-mentioned structural differences it is quite evident that the genus *Boros*, although closely related to all of the three discussed families, can not be included in any of them, and possesses sufficient distinguishing characters to warrant its being recognized as the larval type of a separate family. The characters of the larva thus lead to the same conclusion which Thomson (*15*) reached in 1859 through his study

of the characters of the imago, and substantiates the correctness of his classification of the Boridae as a separate family.

For the larval form of the Boridae the following family definition is outlined. It is based exclusively on the characters found in the mature larva of the species *Boros unicolor* Say, the larvae of the other species of the genus being unknown.

FAMILY BORIDAE HERBST

Larva elongate, depressed, with sub-parallel sides, well sclerotized, smooth shining, with few and short setae, color testaceous. Head extended. Labrum, distinct; clypeus fused with frons; on each side with five ocelli, arranged in two transverse groups; antenna contiguous to mouth-frame, consisting of three setiferous articles, the second bearing a minute apical supplementary appendix. Mandibles slightly flattened, asymmetrical, with apex tridentate, cutting edge bearing two additional small teeth, molar structure quite strong, protruding, and with carinate grinding surface. Ventral mouth parts retracted; maxilla with entire and obtuse mala, maxillary palpus with three articles; cardo divided into two parts; maxillary articulating area large and distinct; gula, submentum, and mentum distinct, prementum[1] broad, labial palpus with two articles; ligula large, subconical and hairy. Epipharynx semi-membranous, bearing two hooks and many minute teeth; hypopharynx with sclerome. Legs all alike, strong and five-jointed; coxae inserted widely apart. Prothorax with very large presternum, consisting of a median spatulate part and two lateral subtriangular parts. Tergal plates of mesothorax, metathorax, and the first eight abdominal segments anteriorly with subtransverse, medianly obsolete linear groove with raised front margin; tergal plate of eighth abdominal segment about twice as long as of ninth (excluding urogomphi); tergal plate of ninth abdominal segment heavily sclerotized, transversely subrectangular, bearing a pair of slightly flattened, backwardly directed, falcate urogomphi; one pair of well sclerotized pits present on the ventral side of the tergal plate in the margin between the bases of the urogomphi. Spiracles annular. First thoracic spiracle dorso-laterally seated in the pre-epipleurum of mesothorax; second thoracic spiracle present in epipleurum of metathorax but vestigial; abdominal spiracles dorso-laterally placed in the terga of the first eight abdominal segments.

EXPLANATION OF PLATE 3.

Figures drawn with aid of camera lucida by the author.)

Fig. 1. *Boros unicolor.* Head. Ventral view; *ca*, cardo; *epc*, epicranium; *gu*, gula; *li*, ligula; *lp*, labial palpus; *ma*, mala maxillaris; *mar*, maxillary articulating area; *me*, mentum; *mxp*, maxillary palpus; *pag*, palpiger, developed as a basal membrane of the maxillary palpus; *paf*, palpifer, developed as a basal membrane of the labial palpus; *pm*, prementum; *sm*, submentum; *sti*, stipes maxillaris.

[1]As "prementum" that part of the labium is designated which lies between the mentum and the ligula, and which morphologically consists of the median fused stipes labii and the labial palpifers.

Fig. 2. *Boros unicolor.* Head. Dorsal view, also diagrammatic sketch of lateral view to show position of ocelli and arrangement of setae in ocellar group; *bm*, basal membrane of antenna; *cl*, clypeus; *epc*, epicranium; *f*, frons; *lab*, labrum; *1*, *2*, *3*, first, second, and third articles of antenna; *tp*, dorsal tentorial pit.

Fig. 3. *Boros unicolor.* Right mandible. Ventral view; a^1, a^2, and a^3, tricuspidate apex; *t*, teeth of cutting edge; *m*, molar part with carinate grinding surface.

Fig. 4. *Boros unicolor.* Left mandible. Dorsal view. Explanation of letters as for figure 3.

Fig. 5. *Boros unicolor.* Part of head and prothoracic and mesothoracic segments. Ventral view; *ep*, epipleurum; ep^1, pre-epipleurum; ep^2, postepipleurum; *eu*, eusternum; h^1, prehypopleurum; h^2, posthypopleurum; *stl*, sternellum; *y*, presternum; y^1, lateral parts of presternum; y^2, median part of presternum; *z*, poststernellum.

Fig. 6. *Boros unicolor.* Maxilla of larva from ventral side: *ca*, cardo divided into two parts. Explanation of letters as for figure 1.

Fig. 7. *Boros unicolor.* Larva. Dorsal view; *VIII*, eighth abdominal segment. *IX*, ninth abdominal segment.

Fig. 8. *Boros unicolor.* Eighth, ninth and tenth abdominal segments. Ventral view; *ep*, abdominal epipleurum; *hp*, abdominal hypopleurum; *ster*, sternal shield of abdominal segment; *ter*, tergal shield of abdominal segment; *VIII*, eighth abdominal segment; *IX*, ninth abdominal segment, and *X*, tenth abdominal segment.

Fig. 9. *Boros unicolor.* Sixth abdominal spiracle with portion of trachea.

Explanation of Plate 4.

(*Figures drawn with aid of camera lucida by the author.*)

Fig. 10. *Boros unicolor.* Anterior portion of head. Dorsal view. Explanation of letters as for Plate 1, figure 2.

Fig. 11. *Boros unicolor.* Epipharynx and anterior margin of labrum; *eph*, epipharynx; *h*, median hooks; *so* and so^2, sensory organs; *t*, teeth; *tb*, transverse band.

Fig. 12. *Boros unicolor.* Metathorax and first abdominal segment. Lateral view. Explanation of letters as for Plate 1, figure 8.

Fig. 13. *Boros unicolor.* Prothoracic leg. Anterior face; *cox*, coxa; *fe*, femur; *ta*, tarsungulus; *ti*, tibia; *tr*, trochanter.

Fig 14. *Tribolium confusum.* Head. Dorsal view. Explanation of letters as for Plate 3, figure 2.

Fig. 15. *Doliema pallida.* Maxilla of larva. Ventral view. Explanation of letters as for Plate 3, figure 6.

Fig. 16. *Boros unicolor.* Labial palpus, hypopharyngeal region and oesophagus. Viewed from buccal cavity; *fm*, fossa for mandible; *hbr*, hypopharyngeal bracon; *hsc*, hypopharyngeal sclerome; *li*, ligula; *lp*, labial palpus; *mea*, median area of hypopharyngeal region; *oes*, oesophagus; *poh*, postero-lateral part of hypopharynx (paragnath ?); *prh*, prehypopharynx.

Fig. 17. *Tenebrio obscurus.* Anterior portion of head. Dorsal view. Explanation of letters as for Plate 3, figure 2.

Fig. 18. *Pytho planus.* Head. Dorsal view; *3*, third article of antenna; explanation of letters as for Plate 3, figure 2.

Fig. 19. *Pytho planus.* Left mandible. Ventral view. Explanation of letters as for Plate 3, figure 3.

Fig. 20. *Othnius* sp. Right mandible. Ventral view; *mt*, teeth of mola; explanation of rest of letters as for Plate 3, figure 3.

Fig. 21. *Pytho planus.* Terga of eighth and ninth abdominal segments. *VIII*, eighth abdominal tergum; *IX*, ninth abdominal tergum.

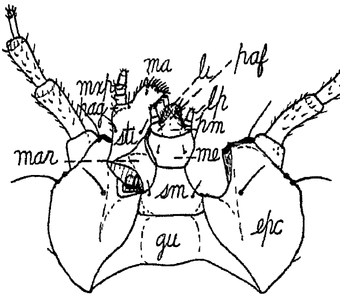
Fig. 22. *Neopyrochroa femoralis.* Terga of eighth and ninth abdominal segments. *VIII* and *IX*, as in figure 21.

Fig. 23. *Neopyrochroa femoralis.* Eighth, ninth, and tenth abdominal segments. Ventral view; *VIII*, eighth abdominal segment; *IX*, ninth abdominal segment; *X*, tenth abdominal segment.

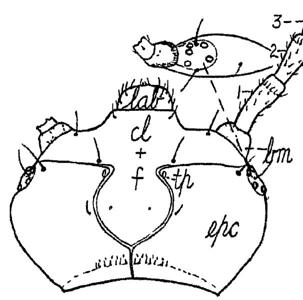
Fig. 24. *Neopyrochroa femoralis.* Epipharynx and anterior margin of labrum. Explanation of letters as for Plate 4, figure 11.

Literature Cited.

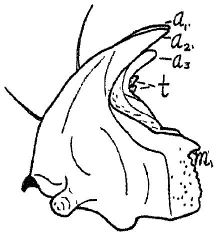
1. Blatchley, W. S.—Coleoptera of Indiana, p. 1303, 1910.
2. Gebien, H.—Tenebrionidae III, Junk Coleopt. Cat. Part 28, p. 463, 1911.
3. Henshaw, Samuel—List of the Coleoptera of America, north of Mexico, p. 125, 1885.
4. Herbst, J. F. W.—Natursystem Aller Insekten, Käfer, Vol. 7, p. 318, 1797.
5. Kiesenwetter, E. A. H. von und Seidlitz, G. von—Naturg. Ins. Deutschl. Coleoptera, Vol. V, p. 201, 1877–1898.
6. LeConte, John L.—Class. Coleop. North Amer., Part I, p. 256, 1862.
7. Leng, C. W.—Cat. Coleop. of Amer. North of Mexico, p. 236, 1920.
8. Leonard, M. D.—A List of the Insects of New York, Cor. Univ. Agr. Expt. Sta. Mem. 101, p. 406, Aug., 1926.
9. Motschulsky, T. Victor von—Bull. Mosc. Vol. XLV, Part II, no. 3, p. 41, 1872.
10. Mulsant, M. E.—Coleop. de France. Latigènes, p. 269, 1854.
11. Panzer, G. W. F.—Faun. Germ. Part 34, Fig. 1, 1796, Redt. Faun. Aust. Ed. II, p. 613, 1858.
12. Redtenbacher, Ludwig von—Faun. Aust. Ed. II, p. 613, 1858.
13. Say, Thomas—Jour. Acad. Nat. Sci. Phila., Vol. 5, p. 238, 1827.
14. Schiödte, J. C.—De Metamorphosi Eleutheratorum Observationes, Kjöbenhavn, Pars. X, Tenebriones, Naturh. Tidsskr. 3 Ser., Vol. XI, 1879, pp. 477–598.
15. Thomson, C. G.—Skandinaviens Coleoptera, Vol. VI, p. 326, 1864.


mxp
pag
ma
li
paf
lp
pm
sti
mar
me
sm
gu
epc

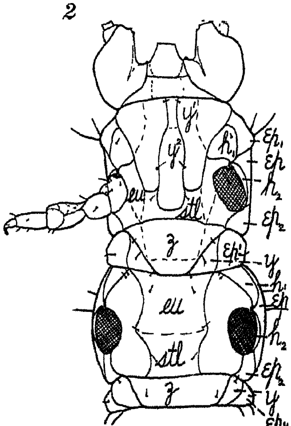
1


3
2
laf
cl
+
f
tp
bm
epc

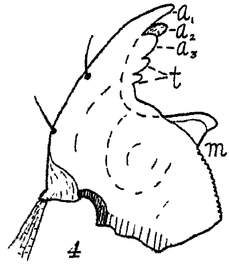
2


a_1
a_2
a_3
t
m_1

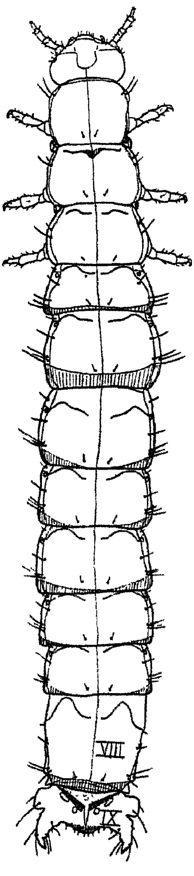
3


y_1
y^2
h_1
ep_1
ep
h_2
ep_2
eu
stl
z
ep
y
h_1
ep
eu
h_2
stl
ep_2
z
y
ep

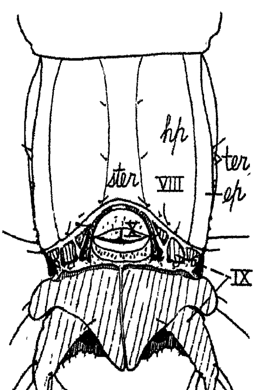
5


a_1
a_2
a_3
t
m

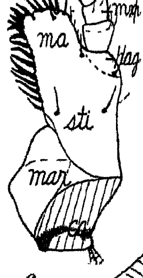
4


VIII
IX

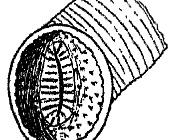
7


hp
ter
ster
VIII
ep
X
IX

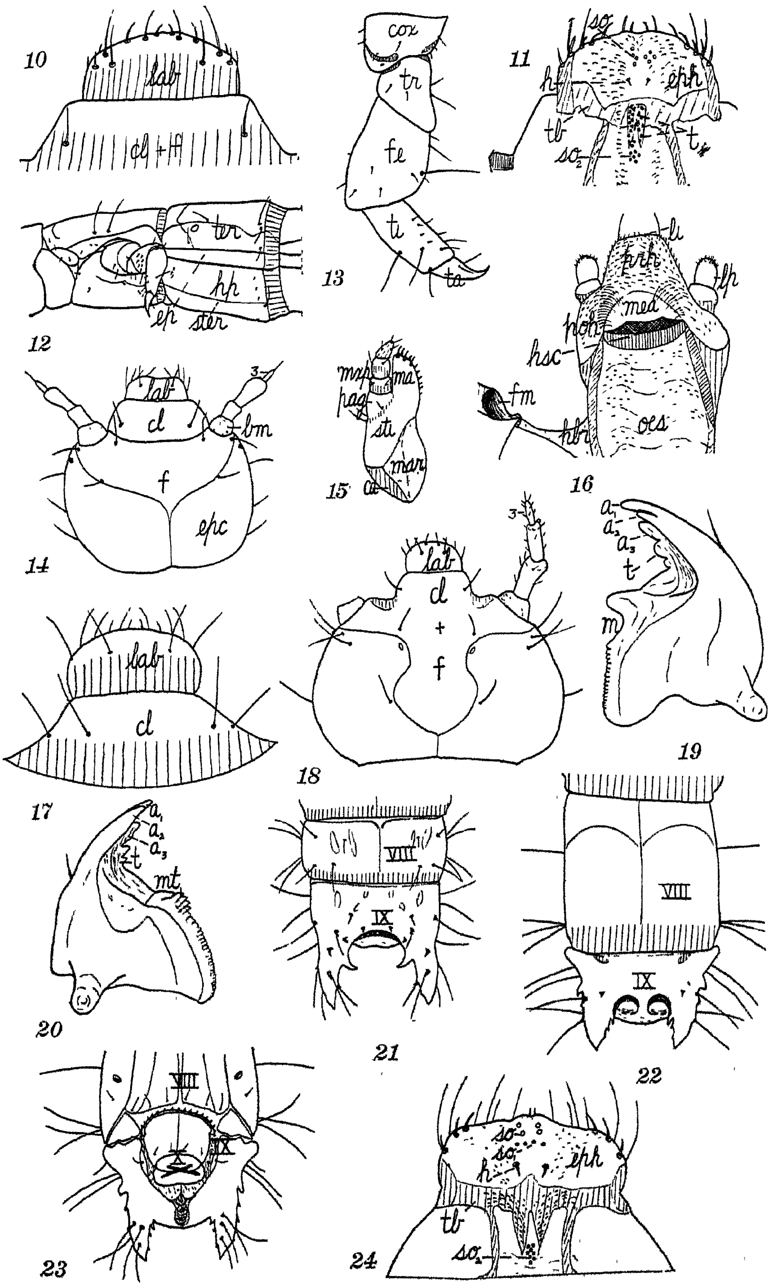
8


mxp
ma
pag
sti
mar
ca

6



9


10
lab
cl + fl
13
cox
tr
fe
ti
ta
11
so
h
eph
tb
so2
12
ter
hp
ep
ster
14
lab
cl
bm
f
epc
15
mxp
ma
pag
sti
mar
ca
16
li
prh
lp
med
poh
hsc
fm
hbr
oes
17
lab
cl
18
lab
cl
+
f
19
a1
a2
a3
t
m
20
a1
a2
a3
t
mt
21
VIII
IX
22
VIII
IX
23
VIII
IX
24
so
so
eph
h
tb
so2

NOTES ON DIPTERA NO. 5.

By J. M. Aldrich, *U. S. National Museum.*

The preceding paper, No. 4, "Notes on Synonymy of Diptera," was published in these Proceedings, Vol. 32, 1930, pp. 25–28.

I am under obligation to Dr. William Schaus for the opportunity to consult in his private library both the first and second editions of Drury's "Illustrations of Exotic Entomology," referred to in the following pages.

1. Possible Occurrence of *Teichomyza fusca Mcq. in* South America.

Several years ago Professor Cockerell sent me four specimens of this common European Ephydrid, three of which were labeled "Ilo, Peru, at light, Aug. 9," the other "Antofagasta, Chile, at light, Aug. 7." At first I thought I had a new genus, and so reported. Some time elapsed, and Professor Cockerell gently reminded me that I had not yet described his new genus. Finally I got to work on the matter, possibly after a second reminder, and about the first thing discovered that it was the European species. Writing to Professor Cockerell for more information, he wrote me that the light was on the Grace steamship on which he was a passenger. As the species breeds in urinals, a question immediately arose whether the species had been actually living on the land, or had been breeding on the boat itself. I inclined to the latter view, although it would seem a simple matter for the fly to get ashore and become introduced while some vessel was in a dock. Professor Cockerell gives the following reasons for believing that the flies came from shore to the light:

1. The Grace boats do not go to Europe, where the fly occurs, but to New York, where it is not known.
2. The electric lights were watched during the voyage and the fly occurred only at the places noted.

The vessel had been docked at Valparaiso a couple of days before, but was off-shore when the fly was collected. In the dry region where the collections were made, conditions on the adjacent shore were very favorable for the breeding of the fly, unflushed urinals being common.

2. Subgenera of *Cuterebra*.

Dr. Arminius Bau has published a subdivision of *Cuterebra* into four subgenera, in Centralblatt f. Bakterologie, Parasitenkunde und Infektionskrankheiten, vol. 77, 1929, pp. 542–544. His grouping of the species is based almost wholly upon the markings of the head. Those which show no markings he puts

in *Paracuterebra*, including *cuniculi* Clark and *ornata* Bau. Since *cuniculi* is the genotype of *Cuterebra*, he should have called this subgenus *Cuterebra*.

Species having the head ornamented only with shining black spots, from one to five pairs, he puts in subgenus *Metacuterebra*, mentioning numerous species.

Species having both shining black areas and white pollinose ones on the head he places in the subgenus *Orthocuterebra*, mentioning numerous species, among them *lepusculi* Tns., which Townsend (Insecutor Inscit. Menst., 5, 1917, p. 25) has shown to be a synonym of *Bogeria princeps* Austen. Since *lepusculi* is a synonym of the genotype of *Bogeria*, obviously the subgenus should have been called *Bogeria*.

Species having no shining black areas but having white pollinose ones he puts in the subgenus *Protocuterebra*, mentioning six species, among them *americana* Fab., which Townsend made the type of *Atrvpoderma*, new genus, in 1919 (Proc. U. S. Nat. Mus., 56, p. 592). Therefore Bau should have used *Atrypoderma* for this group.

To remove any uncertainty I designate the following as subgenotypes: for *Paracuterebra*, *cuniculi* Clark; for *Orthocuterebra*, *lepusculi* Tns.; and for *Protocuterebra*, *Musca americana* Fab. My acquaintance with the species of *Metacuterebra* is not sufficient to justify me in selecting a type.

3. What is *Musca pilosa* Drury?

In the first edition of his "Illustrations of Exotic Entomology," vol. 1, 1770, p. 109, Drury gives a brief description of an unnamed fly, which is figured on plate 45, fig. 7. No locality is mentioned, but the other insects on the plate are from Jamaica and Antigua. In the index he cites the figure as *Musca pilosa*. In the second edition of the work, 1837, edited by Westwood, the description of the fly is on page 104, where Westwood has changed the name to *Echinomyia pilosa*. He distinctly states in his introduction that he did not see the specimens, hence his new generic reference is merely from the figure.

Drury's description is brief and gives few characters; it is as follows:

"The *Head*, is red brown.—The *Eyes*, the color of horn.—The *Antennae*, are short and thick, without any hairs.—The *Thorax* and *Abdomen*, are entirely covered with thick black hairs, or rather bristles, when compared with the size of the insect. The *Wings* (only two), are opake and brown, not transparent.—The *Breast*, is black, and covered with black bristles as the abdomen. —The *Legs*, are also black, with a number of spines on each."

The figure shows golden pollen on head, but the main character shown is the abdominal spines, which are clearly represented as

very numerous, covering the abdomen. The wings in the figure are not so black as the description indicates.

I know of only one specimen from Jamaica which has the abundant spines shown in *pilosa;* this is Townsend's type of *Hystriciella aurifrons*, the species being also the type of the genus. It is in the National Museum (Riley Collection). I think it is certainly the same species, if a specimen can ever be identified from such an early figure.

Now as to the status of the genus *Hystriciella.* The genus and species were described by Townsend in Insecutor Inscit. Menstruus, vol. 3, 1915, p. 95. Townsend compares it with *Hystricia*, pointing out various differences. If he had compared it with *Jurinia* (genotype *gagatea* R. D., as identified by Townsend in the National Museum), these differences would have disappeared almost entirely. The two species are very much alike; the area covered by the dense spines is about the same in both. but there are more spines in *pilosa.* My conclusion is that *Jurinia pilosa* is the correct name for the species, making Townsend's genus and species synonymous.

In this connection it is necessary to consider the somewhat involved question of the correct interpretation of *Musca hystrix* Fabricius. It was described by Fabricius in Systema Entomologiae, 1775, p. 777, in the following terms:

> "Musca hystrix; antennis setariis, pilosissima, atra, ore albicante. Statura M. ferae at triplo minor, tota atra, nitens, immaculata, pilis densissimis, elongatis, rigidis tecta."

The habitat was "America," and he cited "Drury, Ins. I, pl. 45, f. 7," apparently considering this as unnamed by Drury. In Systema Antliatorum, 1805, p. 310, he referred the species to *Tachina*, still citing Drury. Wiedemann, Auss. Zweif. Ins., vil. 2, 1830, p. 283, quoted the original description and gave a new one from specimens in the Fabrician collection and his own, noting that the size indicated by Fabricius was altogether too small. He also described another species which he found under the name of *hystrix* in the Copenhagen Museum; this was obviously different and need not be discussed here. I saw what was probably the same specimen in the Copenhagen Museum, and noted that "pilis densissimis" does not apply at all.

It is practically certain that the species described as *hystrix* by Wiedemann in his own and the Fabrician collection, was not the same as the one originally described by Fabricius. We know what it was, as Brauer and Bergenstamm, Zweifl. Kais. Mus., iv, 1889, 133, made the Wiedemann specimens type of the genus *Tachinodes*, which in the same work, vi, 1893, p. 146, they made a synonym of *Archytas* Jaennicke. In the latter place they give a partial description, indicating among other items that the

species has only marginal bristles on the abdomen. This certainly can not be made to harmonize with Fabricius's "pilis densissimis."

Williston had already discussed *hystrix*, in Trans. Amer. Ent. Soc., vol. 13, 1886, p. 299. He referred it to *Jurinia*, and analyzed his material into three "forms or species." All had a row of spines on the second abdominal segment, and the third antennal joint was said to be but little longer or not longer than the second; while *hystrix* of Wiedemann (B. B.) has only a single pair of marginals on the second abdominal segment, the third antennal joint longer and very convex, etc. On the following page he described *Jurinia hystricoides*, which is the same as *hystrix* of Wiedemann.

Brauer, Sitzungsber. Kais. Akad., vol. 107, 1898, p. 501, reported that the type of *Jurinia metallica* Robineau-Desvoidy (in the Bigot collection) is apparently the same species as *hystricoides* of Williston.

Coquillett, Revision N. A. Tachinidae, 1897, p. 142, has *Archytas hystrix* based on an identification of Brauer and Bergenstamm (therefore *hystrix* of Wiedemann), which is as he indicates the same as *Jurinia hystricoides* Williston. He places Williston's *hystrix* in *Jurinella* as a synonym of *metallica* R. D. Afterward, in Proc. U. S. Nat. Mus., vol. 25, 1902, p. 120, he adopts Brauer's conclusion and places *metallica* under his *hystrix*, adopting *adusta* V. d. w. (which he had made a synonym) as the available name for Williston's *hystrix*.

Townsend, Insecutor Inscit. Menst., vol. 3, 1916, p. 73, described *Jurinopsis floridensis*, new genus and species, which is, as he says, Williston's *hystrix*; his type is a male with very black antennae and brownish palpi, agreeing with Williston's form b. This being a different species does not affect the history of *hystrix* Fabricius nor of *hystrix* Wiedemann.

Curran, Canadian Entomologist, vol. 60, 1928, p. 204, places *hystrix* Williston and *hystrix* Coquillett (in part) as synonyms of *metallica* R. D., in the genus Archytas. On page 206 of the same work he adopts *pilosa* Drury as the proper name for *hystrix* Wiedemann.

Now as to the valid names for the species. As already intimated, I think we must let the original *hystrix* fall as a synonym of *pilosa*, not in *Archytas* where Curran places it, but in *Jurinia*. *Juriniopsis* of Townsend may stand as a good genus, but his *floridensis* is antedated by *Jurinia adusta* Van der Wulp, Biologia, Dipt., ii, 1890, p. 28. I saw the types of *adusta* in the British Museum. Walker described the same species as *Tachina basalis* in 1849, List etc., pt. 4, p. 713; but he had preoccupied this name himself in 1837. I saw the type of Walker 1849. *Juriniopsis adusta* V. D. W. may therefore stand for this species.

Hystrix of Wiedemann is the same as *Jurinia metallica*

Robineau-Desvoidy (Myodaires, 1830, p. 35), the type of which I saw in the Collin (Bigot) collection, as Brauer did. It bears a label in the handwriting of Robineau. I would call the species *Archytas metalica* R. D.

We therefore have the following:

Jurinia pilosa Drury.
Musca pilosa Drury.
Musca hystrix Fabricius.
Hystriciella aurifrons Townsend.
Juriniopsis adusta Van der Wulp.
Jurinia adusta Van der Wulp.
Jurinia hystrix Williston.
Jurinella metallica Coq. 1897.
Tachina basalis Walker (preoc.).
Juriniopsis floridensis Townsend.
Jurinia metallica Curran.
Archytas metallica Robineau-Desvoidy.
Jurinia metallica Robineau-Desvoidy.
Tachina hystrix Wiedemann.
Tachinodes hystrix Brauer and Bergenstamm, 1889.
Archytas hystrix Brauer and Bergenstamm, 1893.
Jurinia hystricoides Williston.
Archytas hystrix Coquillett.
Archytas pilosa Curran.

Eurycephalomyia Hendel. I am confident that I have at last unraveled the mystery of this genus. It was described by Roeder in Berl. Ent. Zeitschrift, vol. 25, 1881, p. 211, as Eurycephala, in the subfamily Ulidiinae of the Ortalidae; the sole species was *myopaeformis*, new, from California. The genus being preoccupied, Hendel proposed to change the name to Eurycephalomyia in Wien. Ent. Zeitung, vol. 26, 1907, p. 98. He did not identify the species, and in his Genera Insectorum paper on Ulidiinae, 1910, p. 68, he quoted the generic and specific descriptions of Roeder. Williston, in his 1908 Manual of North American Diptera, p. 277, placed the genus from the description among the Ulidiinae. Coquillett redescribed *myopaeformis* as *Tetanops polita* in Journal N. Y. Ent. Soc., vol. 8, 1900, p. 22, his description being based on three females from Colorado. Hendel gave it a third name, as *Tetanops aldrichi*, in Wien. Ent. Zeitung, vol. 30, 1911, p. 20, basing his description on several specimens of both sexes which I sent him, collected at Moscow, Idaho. He had not seen *polita* Coq., and its description seemed to indicate some color differences. I have compared Coquillett's types with a part of my Idaho series which I retained, and which I had compared with the specimens sent to Hendel; he did not return any types to me.

For many years I did not have access to Roeder's description, and recently have been engaged in other families and have made no recent efforts to identify the species. I now find that Roeder's description leaves practically no doubt of the synonymy indicated above. The mystery arose from having Eurycephalomyia in the wrong subfamily; it belongs to Ortalinae.

The species is common in the West, and I obtained a long series on flowers at Moscow, Idaho. Ira M. Hawley reported it as injuring sugar beets in Utah, in Journal Econ. Ent., vol. 15, 1922, p. 388, and vol. 16, 1923, p. 378; the larvae burrow in the beet. He called it *Teganops aldrichi* from my identification, and it was mentioned by Essig with this habit in his insects of Western North America, 1926, p. 605. It has also been reported under this name from Lethbridge, Alta., by Gibson (The Entomological Record, 1926, in Report Ent. Coc. Ont.), and from Burns, Ore., by Cole and Lovett, in their List of the Diptera of Oregon, 1921, p. 328. Cole also figured the genitalia of the male under this name, in Proceedings Cal. Acad. Sci., vol. 16, 1927, 485, figs. 249, 250.

The genus I believe to be a valid one, differing from Tetanops not only in the wrinkling of the front and cheek (below the eye), but also in the shape of the head, which is shorter and has the front more nearly vertical than in *myopina* Fall., type of Tetanops, with which our *T. luridipennis* and *integra* substantially agree. Roeder, while placing it in Ulidiinae, stated that it forms a transition to the Ortalinae. The punctures on the front which are mentioned by Roeder are really of insignificant size compared with those of Tetanops.

A NEW SPECIES OF ENCARSIA FROM CUBA (HYMENOPTERA: APHELININAE).

By A. B. Gahan,
U. S. Department of Agriculture, Bureau of Entomology.

What appears to be a new species of Aphelininae recently received from the Estacion Experimental Agronomica of Cuba is herewith described.

Encarsia cubensis, n. sp.

Belongs to the group having only four joints in the middle tarsus. Is readily separated from all of the species known to me except *E. quaintancei* Howard by the presence of an area around the stigmal vein bare of cilia. May be readily distinguished from *quaintancei* by the fact that the second funicle joint is longer than either the first or third and by the fact that the

propodeum and a broad band at the base of the abdomen are pale yellow like the scutellum.

Female.—Length 0.5 mm. Antennae slightly clavate, the last three joints slightly thicker than the three preceding; pedicel twice as long as the first flagellar joint, which is about as long as broad; second flagellar joint about as long as the pedicel and distinctly a little longer than the third; fourth joint equal to the second; two apical joints subequal in length, each very slightly longer than the fourth flagellar joint. Eyes sparsely hairy. Praescutum and axillae reticulated; scutellum and scapulae appearing granular under high magnification; praescutum with four bristles, one at each anterior angle and a pair in front of the scutellum; scutellum about twice as broad as long, with four bristles; propodeum very short, its spiracles elliptical. Forewings rather small, measuring about 0.48 mm. from base to apex and about 0.17 mm. in width at the widest point; marginal vein very slightly longer than submarginal; postmarginal absent, stigmal short; submarginal vein with two short erect bristles above; marginal vein with eight marginal bristles; longest marginal cilia equal in length to approximately one-third the greatest width of wing; disk of wing ciliated but with a moderately large area adjacent to the apex of venation, a narrow elongated area near the posterior margin in apical half of wing, and the basal portion to apex of submarginal vein bare. Fore and hind tarsi distinctly 5-jointed, the middle pair distinctly 4-jointed. Abdomen ovate, as long as or a little longer than the thorax and usually somewhat narrower than the thorax; ovipositor not exerted, originating at about basal one-third of abdomen. Head, pronotum, praescutum, axilae, pleura, and a broad band across the abdomen near the middle, as also the basal lateral margins of abdomen, black or blackish. Antennae, orbits very narrowly, a transverse line across the front below ocelli, scapulae for the most part, scutellum, propodeum, all legs, and the base as well as apex of abdomen, pale yellowish.

Male.—Unknown.

Type-locality.—Santiago de las Vegas, Cuba.

Type.—Cat. No. 43530, U. S. N. M.

Described from three females mounted on a single slide in Hoyen solution, received from S. C. Bruner and said to have been reared from the woolly white fly, *Aleurothrixus howardi* (Quaintance) in Cuba.

This species in the opinion of the writer could be placed in *Prospaltella* about as appropriately as in *Encarsia* except for the four jointed middle tarsi. The three apical joints of the antennae are slightly thickened but the last two joints seem to be slightly more closely joined to each other than to the preceding joint. One could interpret the antennae as having a three-jointed funicle and a three-jointed club, or a four-jointed funicle and a two-jointed club, with about equal propriety.

MINUTES OF THE 428th REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON.

The 428th meeting of the Entomological Society of Washington was held April 2, 1931, in Room 43 of the new building of the National Museum. Dr. A. C. Baker, President, presided. There were present 28 members and 27 visitors. The minutes of the previous meeting were read and approved. D. P. Curry, Assistant Chief Health Officer of the Panama Canal Zone, Ancon, Panama, was admitted to membership. The chairman of the program committee read a letter from Dr. F. L. Campbell, of the U. S. Entomological Laboratory at Blair Road, Takoma Park, Md., extending invitation to the society to meet at this laboratory at the time of the regular meeting on June 4, next. This invitation was accepted with thanks by vote of the society.

The first communication on the regular program was presented by Dr. W. S. Hough, Winchester Research Laboratory of the Virginia Agricultural Experiment Station, Blacksburg, Va., and was entitled, "Codling moth experimental work in Virginia with special reference to resistance to Arsenate of lead poisoning." Working with codling moth larvae from Grand Junction, Colorado, and native Virginia larvae at Winchester, Virginia, since 1927, it has been shown that these larvae represent two distinct strains with respect to their ability to enter fruit sprayed with such materials as lead arsenate, cryolite, barium fluosilicate and rotenone. Crosses are intermediate between the tolerant Colorado strain and the intolerant Virginia strain. Larvae from Washington State compare favorably with the Colorado-Virginia crosses. The Colorado larvae also show their superiority over the Virginia larvae in their ability to enter unsprayed fruit and to endure starvation. Factors influencing the origin of the strains and the nature of the difficulties are under investigation. (Author's abstract.) A number of slides relative to experimental work and comparative tabulations were shown. Comments were made on this paper by McIndoo, Howard, Hyslop, Baker, Campbell, Wood, Wadley, Larrimer, Rohwer, Bulger, and F. F. Smith.

The second communication on the program was given by Dr. M. W. Blackman of the Bureau of Entomology and was entitled, "Some factors influencing brood survival of the Black Hills beetle." The most important factors affecting brood survival of the bark beetle aside from available food are the climatic factors including moisture, temperature and air currents. Of these the amount of moisture in the inner bark in which the larvae live is especially important in seasons where the soil moisture available to the tree is deficient. At such times there is a direct correlation between subcortical moisture and brood survival. There is also considerable evidence to indicate that epidemics of the Black Hills beetle develop during periods of years when available soil moisture is greater than normal and that they are naturally controlled by several seasons of stronger deficient soil moisture. The reverse of this seems to be true with many other bark beetles. High subcortical temperature is also fatal to brood but the development of lethal temperatures is often prevented by strong air currents which serve to equalize air-temperature and bark-temperature. Air currents may affect the brood adversely by promoting desiccation of the bark. Of the insect factors affecting survival the most important are the larvae of Ceram-

bycids, which often rob the barkbeetles by eating a large portion of the inner bark, and also incidentally eat the larvae and pupae as well. Of the bird enemies the nuthatches and bluebirds, which prey upon the adult beetles during flight and attack, are considerably more important than the woodpeckers, which while they destroy many larvae, also destroy a correspondingly larger percent of the insect enemies inhabiting the bark. (Author's abstract.) Comments on this paper were made by Baker and Rohwer.

A visitor, Prof. Wm. E. Hoffmann, of the Lingnan University of Canton, China, on invitation, addressed the society and gave a brief résumé of his work in China and of entomological conditions in various sections of that country. He stressed the difficulties of conducting research work because of the unsettled political conditions and civil war and the extreme handicap of dissemination of the information obtained because of the limitations of popular use of the language among research workers, in other countries. He referred very briefly to the antiquity of the country and the historic background of all present day scientific work. Comparative data were given on methods of conducting university training and research work in China and other countries, notably Japan and Formosa. He directed special attention to a scientific quarterly now being issued in that country under the auspices of the Lingnan University and to periodicals published in other parts of the country.

Meeting adjourned at 10:10 P. M.

J. S. WADE,
Recording Secretary.

Actual date of publication, May 15, 1931.

PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 33 JUNE, 1931 No. 6

ON THE CLASSIFICATION OF BRAZILIAN CULICIDAE WITH SPECIAL REFERENCE TO THOSE CAPABLE OF HARBORING THE YELLOW FEVER VIRUS.[1]

By RAYMOND C. SHANNON.

(From the Yellow Fever Laboratory of the International Health Division of the Rockefeller Foundation, at Bahia, Brazil.)

CONTENTS.

I. INTRODUCTION.

Experiments carried on in the yellow fever laboratory at Bahia during the last two years (1929–1930, Davis and Shannon) indicate that the Brazilian species of Culicidae which are capable of harboring the yellow fever virus for periods of time longer than the usual incubation period in stegomyia all belong to a single tribe, the Culicini, and further that this condition is restricted to certain genera within the tribe, namely: *Psorophora*, *Aëdes*, and *Mansonia*.

The only other species of the tribe Culicini which annoy man to any great extent belong to the genus *Culex*, and of these, *C. quinquefasciatus* is the chief offender in the tropics. However, experiments conducted on this species have shown it to be at least a highly unfavorable host for the virus of yellow fever.

In connection with these observations, it is of interest to note that the species of the genus *Culex* are considered to have been, originally, feeders on avian blood. (It would appear that *C. quinquefasciatus* has retained this instinct to a large extent,

[1]The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of the Rockefeller Foundation.

since it feeds upon birds with the same alacrity as it feeds upon man.) On the other hand, the species of *Psorophora*, *Aedes*, and *Mansonia* feed primarily cn mammalian blood.

Of the other tropical American genera belonging to the tribe Culicini, namely, *Haemagogus*, *Aëdomyia*, *Orthopodomyia*, *Lutzia*, and *Deinocerites*, it is probable that only the first, because of its close relation to *Aëdes*, will be found capable of harboring the yellow fever virus for an appreciable length of time. *Aedomyia* rarely attacks mammalian hosts; in fact, the evidence at present available indicates that it prefers avian blood. The species of *Orthopodomyia* and *Lutzia* are not known to attack men. *Deinocerites*, a crab-hole breeding species confined to the Caribbean coast region, attacks man rather rarely. As this genus is directly derived from the genus *Culex*, it is probable that it likewise can not harbor the yellow fever virus. *Culicella*, the only other Culicine genus occurring in America, is confined strictly to temperate regions.

A number of experiments made on species belonging to the Sabethine and Anopheline tribes, indicate that these mosquitoes are unfavorable hosts for the virus. The tribe Megarhinini may be entirely disregarded, as it contains no blood-sucking members; while the Uranotaeniini attack man with extreme rarity.

The foregoing observations are in accord with those made in the yellow fever laboratory at Lagos, Nigeria, with but one exception. Successful transmission of yellow fever by means of biting was obtained there with a number of species of the genus *Aëdes* and with *Mansonia africanus*. *Eretmopodites chrysogaster*, a derivitive of the genus *Aëdes*, proved to be a favorable host for the virus. The exception mentioned occurred in the case of a species of *Culex*, namely, *C. thalassius*. Infection was obtained by injecting specimens of this species after an "adequate" incubation period. (Bauer, 1928; Philip, 1929, 1930.)

Although the primary object of the present paper is to give a revision of the Brazilian species belonging to the genera *Psorophora*, *Aëdes*, and *Mansonia*, it is considered advisable, for purposes of orientation, to include a classification of the tribes and genera of the subfamily Culicini (Brazilian) as a whole.

Experience has shown that the key to the American tribes and genera proposed by Dyar and Shannon (1924), a modification of that proposed by Edwards (1922), is unsuitable except for the specialist. Most of the characters used in it are very minute and difficult of detection; whereas some of the really obvious characters are omitted. The reason for this course was that the more obvious characters are frequently not absolute and are usually applicable only to the female sex, whereas the characters used appeared to be absolute and common to both

sexes. However, many of the less absolute and uni-sexual characters can be of material assistance in the classification of the tribes and genera, especially since, as a matter of fact, it is specimens of the female sex that are more commonly collected; and even in the cases where males are obtained, as by rearing, females as well are incidentally procured.

It has been more or less customary in the past to avoid using characters based on the scales for tribal and generic distinctions, evidently because of the belief that such characters are too plastic and therefore do not posses generic or tribal value. However, the general appearance of the insects is largely dependent upon the development and color of the scales, and the use of scale characters will doubtless prove of value even in generic and tribal keys. In fact, at least as far as the American mosquitoes are concerned, one of the most absolute characters (which is also easy of discernment) for separating the tribe Anophelini from all other tribes, is based on scales.

In the key here presented, therefore, an attempt has been made to include all of the characters, whether absolute or not, which may prove of value in classification. The more obvious characters, frequently possessed only by the female, are in bold face type. Thus for preliminary and rapid identification only the characters given in bold face type need be considered.

All the tribes and all but two of the genera found in America occur in Brazil. Although the key has been prepared primarily for the identification of the Brazilian fauna, the two genera not found here (*Culiseta* and *Deinocerites*) are also included for the sake of completeness.

The fact that the key has been based primarily on Brazilian mosquitoes makes it possible to emphasize certain characters for the separation of the three genera, *Psorophora*, *Aëdes*, and *Mansonia*, which are probably the only Brazilian genera that have any important relation to yellow fever. Thus, although the nature of the wing scales easily distinguishes the species of *Mansonia* from those of the Brazilian species of *Aëdes*, there are two North American Aëdines (*grossbecki* and *squamiger*) which also have large wing scales. However, these two may be easily distinguished from *Mansonia* by the uniformly black proboscis and by the scales on the mesopleura (preanepisternum), characters obviously more easily apprehended than the presence or absence of setae on the stem vein, the character formerly utilized by Dyar and Shannon.

Certain characters, apparently not before used in mosquito taxonomy, are also included in the key. One of these is concerned with the separation of the Anophelini on the basis of the absence of scales on the first abdominal tergite. It is evidently a character of tribal value, as shown by the following discussion.

II. RELATION BETWEEN THE HABITS OF THE ADULTS AND THEIR EXTERNAL CHARACTERS.

Inasmuch as habits influence the development of characters, or vice versa, a knowledge of one is of assistance in understanding the other.

The family Culicidae probably developed from a type possessing a short proboscis (i.e. shorter than the head); five segmented, pendulous palpi which exceeded the length of the proboscis; and a simple vestiture of fine hairs on the head, body, legs, and wing veins.

These primitive features are still retained by one subfamily of the Culicidae, the Dixinae, while the only important departure shown by the Chaoborinae is the scale-like development of the vestiture of the wing veins.

All the species of the subfamily Culicinae, however, have the greatly elongated proboscis and the palpi more or less straight and directed forward, exceeding the length of the proboscis only in the male sex of certain species; the males frequently also have the apical segments directed upward. All these species have a more or less well developed vestiture of scales on the occiput, body, and wing veins. The subgenus *Stethomyia* (*Anopheles*) is probably the nearest approach to the primitive type among the American mosquitoes as regards vestiture; the proboscis and palpi are greatly elongated and approximate in length, which no doubt was the condition existing in the progenitors of the Culicinae, or true mosquitoes.

The extreme departure from the *Stethomyia* type is found in the species of the genus *Sabethes:* proboscis long and slender; palpus with but a single, forward directed segment far shorter than the proboscis; the hairs of the head and body and wing veins almost entirely replaced by broad flat scales, mostly of a deep metallic coloration; and a remarkable development of scales on the legs, forming broad, blade-like structures.

The habits probably most responsible for the development or modification of adult characters are: (1) food habits; (2) time of activity; (3) modes of concealment; (4) methods of attack; (5) mating attitudes.

The subject is necessarily an involved one, and therefore attention can be drawn to but few of the outstanding features. Incidentally, it may be that because the female has undergone greater changes in habits than the male, she has also been the more completely modified structurally; while the male still retains more or less completely many of the primitive features.

(1) Food Habits.

The more tangible modifications have taken place in the mouth parts (clypeus, palpi, and proboscis), flight ability, and

mode of attack (e.g., contrast the methods of stegomyia, *Mansonia*, and *Wyeomyia* species), and probably certain modifications of the legs and claws.

Modifications of the mouth parts.—Probably all the Brazilian Culicines, except *Megarhinus*, *Lutzia*, and possibly *Orthopodomyia* and some species of *Culex*, suck blood.

It is apparent, however, that the blood-sucking instinct is not equally developed in all the blood-sucking species. These differences in food habits no doubt have brought about some of the modifications of the mouth parts which are discussed below.

(a) *The proboscis.*

The proboscis is straight in all mosquitoes except those of the genus *Megarhinus* and certain species of *Wyeomyia* (subgenera *Dodecamyia* and *Dyarina*). The latter are blood-sucking and probably feed on flowers as well. The former feed only on flowers and probably on honey dew, and the proboscis is peculiarly modified accordingly. The basal portion is rigid and stout but tapers outwardly, forming a slender downward-curved organ. However, the curved portion is very flexible during life and can be straightened and turned with the greatest ease when the insect is searching for food or water.

In most of the other Culicines the proboscis is of remarkable uniformity; it varies little as a rule in length and girth, and only in certain groups and species are definite markings present.

(b) *The palpi.*

Originally, these structures were probably elongated and straightened to serve as a protection for the long, slender proboscis. At least it would appear that the elongated condition of the palpi was the primitive one for the group. This condition prevailed in practically all Anophelines (a recently described Old World species of Anophelini, *Brugella travestitus* Brug., has very short palpi in both sexes, *vide* Edwards, 1930). Long palpi, which not infrequently exceed the length of the proboscis, also occur in all males of *Megarhinus*, in the majority of the Culicini, and in a few species of the Sabethini (all *Joblotia* and certain species of *Goeldia*). The palpi are very short in the tribe Uranotaeniini and in all other Sabethines; moderately short or very short in *Aëdeomyia*, and in certain species of *Haemagogus*, *Aëdes*, and *Culex* (Culicini).

In the females (except the Anophelines) the palpi present a wide range of variation. Not only are they reduced in length (usually considerably), but also in the number of segments. Fusion appears to take place chiefly at the base of the organs, but it is apparent in some cases that the apical segment or segments have disappeared.

It is possible that the variation results from differences in mode of attack or of feeding. However, during the act of feeding, the palpi are directed upward, and when the proboscis is deeply imbedded, the palpi are at right angles to the proboscis. This condition is common to *Anopheles*, *Mansonia*, *Aëdes*, and *Culex*, and probably to all other genera as well.

In length of palpi, the species of *Megarhinus* present an intermediate condition between the long and the short types. The palpi may be nearly as long (subgenus *Ankylorhynchus*) or two-thirds as long (subgenus *Megarhinus*) as the proboscis, but always exceed the antennae in length. The females of both subgenera show only three large, distinct segments (four in the male, the basal segment being fused with the one following). The reduction in this case has occurred at the terminal end of the palpus, as a rudimentary segment can be seen at the apex.

The greatest variation occurs in the tribe Culicini, which contains the most blood-thirsty members of the family. Only in certain species of *Psorophora* do the palpi approximate half the length of the proboscis, but even in these cases, they are decidedly shorter than the antennae. Certain species (e.g., *Aedes scapularis*) still retain the full set of segments, but all have been greatly reduced in size, principally the first, second, and fifth segments. The majority of species, however, possessed only three to four segments, including the fused basal joint.

The greatest reduction has occurred in the tribes Uranotaeniini and Sabethini, which have only a single segment (two, counting the fused basal segment).

(c) *The clypeus.*

This structure is peculiar in that it appears to be developed in accordance with the intensity of the blood-feeding habits. The females of most Culicini and Anophelini have a more or less well developed collar of sclerotin surrounding the base of the mouth parts; whereas in all males and in the females of *Megarhinus*, *Uranotaenia*, and the Sabethines and certain Culicines as well, the sclerotization is limited to the upper portion of the clypeus, which appears as a lip-like structure between the antennae and the mouth parts. In *Megarhinus*, it differs further, being much broader than it is long. It is at least as long as it is broad in all other tribes.

(2) Time of Activity.

The most striking modifications in appearance, affecting chiefly the vestiture and coloration, appears to have resulted from the differences in the time of activity. Apparently the more important distinction that should be made in this connec-

tion is the time and manner of mating (i. e., courtship). This, in turn, may possibly be due to some fundamental difference in biology, such as change of larval habitat or feeding methods or both.

The males of many of the Nematocerous Diptera, which are aquatic in the immature stages, orient themselves to some conspicuous object at the time of mating, and are thus enabled to form swarms to which the females are attracted. Swarming usually occurs during twilight hours. Among such species the localizing of the males is probably sufficient to overcome the difficulties of the sexes in finding one another, and consequently there is little need for bright colors, which otherwise would have had to be developed for the purpose of attracting the sexes, unless the insects resorted to still other methods. In this connection, it may be pointed out that the species which swarm usually have sombre colors, or if they possess definite markings, these are not, as a rule, of metallic lustre.

The males of most, or all, of the more primitive mosquitoes form their swarms about dusk, and it is noteworthy that although many have definite color markings, these consist of various shades of black, brown, and white, and are almost invariably of a non-metallic nature.

It may be assumed, therefore, that the progenitors of the present day mosquitoes were of a uniformly dark color, without scales, except possibly on the wing veins, and that they accomplished the act of mating through the process of swarming during twilight hours.

The Brazilian species which more nearly approach this primitive type of vestiture (general absence of scales) belong to the Anopheline subgenus *Stethomyia.* Unfortunately nothing is known of their mating habits, but the females of this group are among the few Anophelines which fly more or less freely and feed during the day. Their chief time of feeding, however, is probably early evening. Also, they are the only Anophelines in America that possess a conspicuous white marking in the *integument* of the mesonotum (a narrow white longitudinal line). Dr. Davis reports that the variety *brasiliensis* of *Anopheles albitarsis* is well known to have day-flying and day-feeding habits in the state of Minas Geraes. It is interesting to note that in this form the tip of the abdomen is conspicuously white.

The Anophelines as a class are probably the most primitive of the American mosquitoes in body vestiture. In the species possessing an elaborate development of scales, these are usually on the wings, although *Chagasia* has a remarkable development of scales on the mesonotum. The Anophelines are the only group which do not have scales on the first abdominal tergite, and in fact most species have few or no abdominal scales.

The majority of the species of the tribe Culicini (exceptions noted below) have the poorest development of scales on the first tergite, frequently consisting of a rather small patch. In the Uranotaeniini, the first tergite is fairly well clothed with scales, but the scales lack a metallic lustre. The highest development occurs in the Megarhinini, Sabethinini, and *Haemagogus* (Culicini) which have the first tergite and the sides of the thorax densely clothed with scales, more or less of a bright metallic lustre. A number of species of the tribe Culicini, chiefly certain species of *Psorophora* and certain subgenera of *Aedes* and *Culex*, as well as all the Brazilian species of *Uranotaenia*, have scattered patches of metallic scales.

The two extremes of scale vestiture, therefore, are represented by *Stethomyia* (*Anopheles*), with only a small patch of scales on the head and hair-like scales on the wings, and *Sabethes*, with a mail-like covering of metallic scales on the occiput and body, and an enormous development of the scales on the legs. Other peculiarities of scale vestiture, as shown by certain members of the family, are the presence of scales on the clypeus (*Stegomyia*, *Aëdomyia*, and certain Sabethines) and on the postnotum (certain Sabethines), normally an absolutely bare structure except for a tuft of setae on the postnotum in the Sabethini and in certain small groups of Culicini.

As stated above, these modifications probably have been brought about chiefly in response to changes in mating habits. This will be shown in the following. We have personally observed the mode of mating of only a few species (stegomyia, *Culex quinquefasciatus*, *Mansonia justamansonia*, *Wyeomyia bromeliarum*, *Limatus durhami*, and *Megarhinus trinidadensis*). Howard, Dyar, and Knab (1912), however, cite observations on *Aëdes atropalpus*, *Culicella*, and various species of *Anopheles*. These observations have been used in the generalization here made.

(a) *Day fliers.*

The day fliers may be divided in two groups: (A) those which mate during the day and (B) those which mate during twilight hours.

Group A.—The Megarhines, Sabethines, certain subgenera of *Aëdes* (*Stegomyia*, *Howardina*, and *Finlaya*), the Aëdine genus *Haemagogus*, and the subgenus *Carrollella* (*Culex*) belong in this group. All are more or less marked with metallic colors, and all breed in natural containers (tree holes, etc.) in or about woodlands, where they are protected from the sun (except the domesticated stegomyia, which breeds in artificial containers in and about houses). As a rule they do not fly far from their larval habitats, and, as far as is known, the males do not form

swarms at the time of mating. The males of these groups are occasionally seen on the wing during the day, whereas the males of group B appear to be on the wing only during twilight hours. The majority of the species are rare, and it is therefore probable that the brilliant colors were developed to enable the sexes to detect one another more easily.

The male Megarhines rest on the leaves of plants in patches of sunlight and await the appearance of the females. Nothing is known regarding the mating of the Culicine groups, except in the case of *Stegomyia*. The males of this group frequently rest in the immediate vicinity of people and await the coming of the female in search for food, or rest on exposed perches (projections of furniture, etc.) where they can easily detect passing females. The Sabethine males drift about the woodlands in slow flight, exhibiting their colors, or, as in the case of the males of *Limatus*, fly slowly up and down tree trunks, purposely exhibiting the blue marking on the proboscis. The latter differ from all other mosquitoes in having a proboscis which can be flexed at the middle; the outer half can be bent upwards at right angles to the basal half, and at the base of the outer half there occurs a conspicuous metallic blue spot edged with black.

Quite probably the Uranotaenines belong to group A, since they possess metallic markings and are day fliers, but their larval habitats (marshy pools, etc.) differ from those of the other species included in this group. Nothing is known regarding their mating habits.

Group B.—At least the majority of the species of *Psorophora*, *Aëdes*, and *Mansonia* probably belong in Group B. In reality, this group is intermediate between the true day fliers and the essentially twilight and night fliers, since, although the females are frequently on the wing in great numbers during the day, seeking food, their hours of greatest activity are at twilight. Moreover, females of this group may be found abroad at all hours of the night. The group differs as a class from Group A, in being ground-water breeders, much stronger fliers, and of a more blood-thirsty nature. The adults usually occur in more or less open land areas, and probably as a result of this their bodies are more heavily sclerotized than are those of most other mosquitoes. This is indicated by the fact that dried specimens undergo less shrinkage than specimens of the majority of the other species. We have personally observed the swarming of *Mansonia justamansonia* only, but according to the records given by Howard, Dyar, and Knab (1912) relative to the swarming of allied species of *Aëdes*, it is probable that the Brazilian species of this genus (aside from those listed under group A) likewise swarm. Nothing is known regarding the mating of the species of *Psorophora*. Certain of these, as well as *Mansonia arribalzagia* and *M. lynchi*, new species described below, have

metallic markings, and in view of this fact, it is possible that they do not form swarms. The genus *Culicella*, which is not found in Brazil, may belong to group B.

(b) *The essentially twilight and night fliers.*

This class includes practically all Anophelines, all species of the genus *Culex*, except *Carrollella* and possibly *Microculex*, and probably the species of *Lutzia* and *Deinocerites* as well.

The typical representatives are either entirely dark in color, or show a color pattern consisting of two or three non-reflecting colors—black, brown, and white. Feeding takes place as a rule only at twilight and during the night; in fact, the great majority of the species are relatively inactive during the day. Consequently, it is to be expected that mating takes place only at twilight, and that the males, in most or all cases, swarm. Such is certainly the case with *Culex quinquefasciatus;* and, according to observations made on several species of *Anopheles* in various parts of the world, this is, in all probability, the case with the Brazilian Anophelines.

Finally, with regard to the modification of vestiture as occasioned by habits, it is of interest to note that the males have not kept pace with the females. In the male the wing scales are usually small and less numerous, while the abdomen is usually less completely scaled and retains the hairs to a greater extent. As a specific example of this, the abdominal tergites of the female *Aëdes taeniorhynchus* are completely scaled and the hairs are greatly reduced in number and size; in the male the sides of the tergites are unscaled, but possess instead numerous long hairs.

(3) Modifications due to Modes of Concealment and Attack.

The only probable example of adaptive coloration to be found in the Brazilian mosquitoes occurs in the genus *Orthopodomyia*. The adults of this genus are mottled brown and white and greatly resemble certain species of *Mansonia*. But while the *Mansoniae* are strong fliers and notoriously blood-thirsty, the *Orthopodomyiae* are not known to suck blood (the clypeus is lip-like; in *Mansonia* it is collar-like); and although the adults are rarely found, they have occasionally been seen resting on tree trunks.

(4) Modifications due to Methods of Attack.

These are not readily apparent in the structure, but express themselves rather in the psychological attitude. The behavior of stegomyia, *Mansonia*, and the Sabethines is characteristic and distinctive. These characters, however, are unsuitable for use in a key and therefore need not be further considered here.

(5) MODIFICATIONS DUE TO METHOD OF MATING.

Probably the chief modification brought about by the method of mating occurs in the claws of the females. Knab (1907) states his belief that in the species in which the claws are simple, the position of copulation is one in which the sexes are end to end and facing in opposite directions (based on observations made on *Anopheles*, *Culex*, and *Culicella*), while in the species in which the female has toothed claws, the position in copulation is face to face, the pair clasping each other (observations made on stegomyia and *Aëdes varipalpus*).

However, this rule does not appear to apply to the Sabethini. The mating position assumed by *Wyeomyia bromeliarum* and *Limatus durhami* is similar to that of stegomyia, yet the females of both of these species have simple claws. On the other hand the claws of the males are somewhat more modified in the members of this tribe than is the case in others.

III. KEY TO THE TRIBES AND GENERA OF BRAZILIAN CULICINAE.

(*The characters which are, as a rule, most convenient for identification, are printed in* **bold face type.**)

Tribe ANOPHELINI.

1. First abdominal tergite without scales; hind coxa slightly shorter than width of mesipimeron; proboscis straight; **palpi of female straight and approximating the length of the proboscis** (certain females of *Megarhinus* have palpi nearly as long as the proboscis, but in these the proboscis is strongly curved downward and the last palpal joint is strongly directed upward); scutellum crescent shaped with the setae uniformly distributed, except in *Chagasia* which has a trilobed scutellum with the setae grouped on the lobes; base of hind coxa distinctly below upper margin of the meso-merocoxa, except in *Stethomyia* where the two are almost on the same level; legs very long and slender; the hind basitarsis longer than the hind tibiae; spiracular setae usually present; sides of thorax with few or no scales; squamal fringe of setae present; color pattern limited to non-metallic shades of black, gray, brown and white (Anophelini)..........2.

   First abdominal sclerite with at least a patch of scales; hind coxa distinctly longer than width of mesepimeron; **palpi of female decidedly shorter than proboscis,** except in certain species of *Megarhinus* (large and of brilliant metallic coloration); scutellum trilobed with the setae grouped on the lobes, except in the Megarhinini, which have the posterior margin straight..........4.

2. Integument of mesonotum with a very slender, distinct white longitudinal line; **antennal hairs of female as long as width of thorax;** spiracular setae absent..........*Stethomyia*.

Integument of mesonotum without a slender white line (some species of the subgenus *Anopheles* have a broad grayish line); **antennal hairs of female much shorter than width of thorax;** spiracular setae present.......................................3.

3. Scutellum trilobed; **antennal hairs of female with knobs of scales at apices of the first seven basal flagellar joints;** terminal antennal joints of male circular in cross section; sides of mesonotum with erect scales; hind basitarsis nearly twice the length of hind tibia.......................................*Chagasia.*

Scutellum crescent shaped; flagellum of female without knobs of scales, except occasionally on first one or two joints; hind basitarsus but little longer than hind tibiae.......................................*Anopheles.*

Tribe MEGARHININI.

4. **Very large more or less metallic colored species with the proboscis strongly curved downward; palpi of female longer than the antennae;** clypeus much broader than long; thorax (including the sides) and abdomen densely covered with scales; length of the forked branches of second vein much shorter than the preceding simple section (similar to that in *Uranotaenia*, see plate 7) a spurious vein present on inner side of fifth vein as well as an outer, the former with a V-shaped ending; base of hind coxa in line with upper margin of the meso-merocoxa; spiracular setae present; *squamae without fringe of setae* ....(Megarhinini) *Megarhinus.*

Proboscis straight, occasionally slightly distorted (except in certain small species of the Sabethines which have a very long, strongly recurved proboscis); **females with the palpi much shorter than the antennae;** clypeus at least as long as broad; no spurious vein on inner side of lower branch of fifth vein (only the outer one present).......................................5.

Tribe URANOTAENIINI.

5. **Small to very small species, the thorax brown with metallic blue or white lines or spots, mesonotal setae well developed;** palpi (both sexes) extremely small, each with but a single segment; spiracular setae present; sterno-pleura with a transverse suture (plainly visible in potash-treated specimens); base of hind coxa distinctly below upper margin of meso-merocoxa; wings without villi (except in *U. geometrica*); **branches of second vein much shorter than the preceding simple section; anal vein ending at, or slightly before, the fork in the fifth vein** (see plate 7) (certain species of *Haemagogus*, tribe Culicini, have their venational characters closely approaching the ones here given; they may easily be distinguished from *Uranotaenia* by the dense covering of metallic scales on the mesonotum and abdomen and lack of setae on the mesonotal disk); wing with patches of silvery white or metallic blue scales, at least along base of fifth vein; *squamae without fringe of setae*.......................................
(Uranotaeniini) *Uranotaenia.*

Mesonotum of various colors, the disk with or without setae; sternopleura without transverse suture; wings with villi; **branches of second vein at least as long as, usually longer than, the preceding simple section** (except certain species of *Haemagogus*, see above); fifth vein uniformly scaled.. 6.

Tribe CULICINI.

6. Palpus of female with two to four differentiated segments; **hind tibia at least as long as fore tibiae; base of hind coxa distinctly below upper margin of meso-merocoxa** (except *Haemagogus*); spiracular setae usually absent; squamae with a fringe of setae (very rarely incomplete); postnotum usually without setae (present in some species of *Haemagogus*, *Deinocerites*, and *Culex*, i. e., the subgenus *Carrollella*); disk of mesonotum usually with setae (Culicini).. 7.

Palpus of female with a single well developed joint; **hind tibia distinctly shorter than fore tibia; base of hind coxa in line with upper margin of meso-merocoxa;** spiracular setae present, except in *Limatus;* squamal fringe incomplete (*Joblotia* and certain species of *Goeldia*) or entirely absent; sides of thorax for the greater part densely scaled; disk of mesonotum densely scaled and without setae; postnotum always with a tuft of setae; metallic colors usually present (especially on head and prothoracic lobes)...... *Sabethini* 16.

7. **Scales on anal vein large and outstanding, their outside margins forming a broad line** (the width being more or less equal to the length of the scales forming the fringe on the posterior margin of the wing).. 8.

Scales on anal vein very small and usually closely applied to the vein, forming but a slender line.......................... 10.

8. **Antennal joints scarcely longer than broad;** clypeus with scales (dull white in color) **wing membrane rather completely overlaid with scales;** width of anal cell only about equal to the length of the scales composing the posterior wing fringe............ *Aedeomyia.*

Antennal joints distinctly longer than broad; clypeus bare; **posterior portion of the wing with large areas of membrane exposed;** width of anal cell distinctly greater than length of fringe scales.. 9.

9. Without spiracular and mid-mesepimeral setae; **fourth and fifth fore tarsal joints shorter than the third**..............*Orthopodomyia.*

Either post-spiracular or mesephimeral setae present (usually both); **fourth and fifth fore tarsal joints longer than the third**.... *Mansonia.*

10. **Brilliant metallic dark blue to green with sides of thorax and abdomen densely white scaled;** first abdominal tergite entirely scaled; tergites three to four and disk of mesonotum without setae; spiracular and post-spiracular setae absent; hind basitarsus distinctly shorter than hind tibia ....*Haemagogus.*

Without brilliant dark blue or green coloration; first abdominal tergite but partially scaled; all abdominal tergites with setae, at least on posterior margins; disk of mesonotum very rarely without setae .... 11.

11. **Lower side of stem vein setose;** spiracular setae present; postspiracular setae absent (*North American*) .... *Culicella.*

Lower side of stem vein bare .... 12.

12. **Hind basitarsus shorter than hind tibia;** eighth abdominal segment of female usually not apparent (being retracted into the seventh), the dorsal surface unscaled, **tip of abdomen rather sharply pointed,** the effect being chiefly from the prominent, laterally flattened, cerci (exceptions: the subgenus *Finlaya* (*Aedes*) has the eighth segment exposed and scaled above and the cerci but little protruding; *Howardina* (*Aëdes*) has both the eighth segment and the cerci short); pulvilli absent; postspiracular setae present .... 13.

Hind basitarsus slightly longer than hind tibia, eighth abdominal segment of female visible and scaled dorsally; **tip of abdomen blunt,** the cerci short, and inconspicuous; pulvilli pressent; post-spiracular and spiracular setae absent .... 14.

13. **Spiracular setae present** .... *Psorophora.*

Spiracular setae absent .... *Aëdes.*

14. **Very large species with dark and light wing areas** .... *Lutzia.*

Moderate to small species; **wing scales all dark** .... 15.

15. Antenna much longer than proboscis (**Caribean coast region**) .... *Deinocerites.*

Antenna not longer than proboscis .... *Culex.*

Tribe SABETHINI.

16. Prothoracic lobes sublateral; palpi of female more than twice the length of clypeus; male palpi usually long, approximating length of proboscis .... 17.

Prothoracic lobes collar-like; palpi of female distinctly shorter than in preceding group; male palpi always short .... 18.

17. **Clypeus setose** .... *Joblotia.*

Clypeus bare .... *Goeldia.*

18. **Mesonotum with brilliant golden and purplish areas;** length of palpus not exceeding that of clypeus; spiracular setae absent, the area being densely scaled .... *Limatus.*

Mesonotum without this coloration; length of palpus somewhat longer than that of clypeus; spiracular setae present .... 19.

19. **At least the middle legs with paddle-like development of scales;** fore femora shorter than the middle ones; prealar and propleural setae absent .... *Sabethes.*

Legs without paddle-like development of scales, i. e., uniformly slender; fore femora as long as middle ones; propleural setae present .... 20.

20. Prothoracic lobes closely approximated dorsally; prealar setae absent; **general coloration a deep metallic blue** .... *Sabethoides.*

Prothoracic lobes moderately approximated; prealar setae present; **rarely with a deep metallic general coloration** ....21.
21. Lower sternopleural setae all located below level of upper margin of meso-merocoxa ....22.
Lower sternopleurals extending above this level........................23.
22. Wing scales broad ....*Miamyia.*
Wing scales narrow ....*Wyeomyia.*
23. Postnotum covered with white scales; wing scales narrow........*Menolepsis.*
Postnotum with few or no scales; wing scales broad...........*Dendromyia.*

IV. CLASSIFICATION OF THE BRAZILIAN REPRESENTATIVES OF PSOROPHORA, AËDES, AND MANSONIA.

Genus **Psorophora** Robineau-Desvoidy, 1827.

A genus evidently of tropical American origin and entirely of American distribution, most probably derived from the Aëdine subgenus *Ochlerotatus.* The largest of the blood-sucking mosquitoes belong here. The larvae occur in transient rainpools and develop with great rapidity.

Three subgenera are recognized on the basis of the external characters of the adults and genitalic characters of the males.

The following subgeneric classification is principally based on the characters of the females.

KEY TO THE SUBGENERA OF PSOROPHORA (*Brazilian Species*).

1. Very large species; mesonotum with smooth longitudinal nude areas. Female: Palpus equal in length to five or more of the basal flagellar segments; tarsal claws toothed ....Subgenus *Psorophora.*
Moderate size species; mesonotum with uniform distribution of scales; palpus of female decidedly shorter ....2.
2. Tarsi dark except the fifth hind tarsal (and sometimes the fourth), which is completely white; claws of the female toothed.................... Subgenus *Janthinosoma.*
Tarsal segments white ringed; claws of the female simple........................ Subgenus *Grabhamia.*

Genus **Aëdes** Meigen.

The genus *Aëdes* is second only to *Culex*, in the number of its species found in America. Dyar (1928) records eight subgenera and 110 species of *Aëdes.* The species of this genus found in North America (75) outnumber all other species of mosquitoes found there. However, the American tropics possess a very limited Aëdine fauna.

Six of the subgenera, but only thirteen of the species, are at present known to occur in Brazil.

A comparison of the subgenera and species occurring in Brazil and in America as a whole follows:

Subgenus	America	Brazil
Aëdes	1	0
Aëdimorphus	1	0
Stegomyia	1	1
Conopostegus	1	1
Howardina	13	2
Finlaya	8	2
Taeniorhynchus	10	2
Ochlerotatus	75	5

The first three subgenera are typically an Old World group, while representatives of probably all the others, except *Conopostegus*, likewise occur there. The Old World possesses, in addition, about eight subgenera not represented in America.

KEY TO THE SUBGENERA OF AËDES (*Brazilian*).

1. Clypeus, prothoracic lobes, mesopleura, mesepimeron (upper portion only) and hind coxa with white scales of metallic lustre; occiput without erect scales (save those composing the ruff); tarsi with white rings. Female: eighth abdominal tergite scaleless and retracted; tarsal claws toothed.......*Stegomyia*.
   Clypeus without scales.......2.
2. Mesepimeron with scales of distinct metallic lustre extending nearly its entire length; other markings distinctly metallic. (Tree-hole breeding species).......3.
   Mesepimeron with the scales confined to the upper half; markings not distinctly metallic; hind coxa with few or no scales. Female: Eighth abdominal tergite unscaled and retracted, the cerci long (exception: *fluviatilis*, as in *Finlaya*); claws toothed. (Ground-water breeders).......5.
3. Hind tarsi with a single pale ring at base of first segment; mesonotum with golden markings. Female: Eighth abdominal segment retracted; cerci short; claws simple.......*Howardina*.
   Hind tarsi without rings or with a broad ring involving the apex of the first and the base of the second segments; mesonotum with silvery markings. Female: Eighth abdominal segment protruding and scaled above; claws toothed.......4.
4. Base of costa black scaled; hind tarsi without ring; a slender line extending full length of mesonotum; occiput without erect scales aside of the ruff.......*Conopostegus*.
   Base of costa white scaled; hind tarsi with rings; mesonotum with sides broadly silvered (at times the silvered areas confluent); occiput with erect scales.......*Finlaya*.
5. Hind tarsi with rings; sides of first abdominal tergite with white scales.. *Taeniorhynchus*.
   Hind tarsi without rings; sides of first tergite without scales....*Ochlerotatus*.

KEY TO SPECIES OF PSOROPHORA AND AËDES

(Because there are but few species in Brazil belonging to these genera and because of the difficulty of separating them generically, they have been grouped together.)

1. Proboscis with a more or less distinct light ring or area at about the middle; tarsi with rings on all the segments ... 2.
   Proboscis uniformly dark ... 4.
2. Abdominal white cross-bands on the basal margins of the tergites; last hind tarsal completely white; claws toothed ... *Aëdes (Taen.) taeniorhynchus.*
   Abdominal cross-bands (more or less interrupted in the middle) on the posterior margins of the tergites; last hind tarsal black with a white basal ring; claws simple ... 3.
   Wings with whitish and dark scales ... *Ps. (Grab.) confinnis.*
   Wing scales all dark ... *Ps. (Grab.) cingulata.*
4. Very large species; length of palpus equal to at least the five basal flagellar joints; mesonotum with scaleless, shining longitudinal areas ... 5.
   Moderate to small species; palpus distinctly shorter; mesonotum uniformly scaled, sometimes sparsely ... 7.
5. Sides of thorax (pleurae) practically scaleless; mesonotum with a pair of uniformly slender white lines ... *Ps. (Ps.) genumaculata.*
   Sides of thorax largely covered with scales ... 6.
6. Median mesonotal stripe golden brown; proepimeron without scales (or extremely few) ... *Ps. (Ps.) ciliata.*
   Median mesonotal stripe black: proepimeron with large scattered white scales ... *Ps. (Ps.) cilipes.*
7. Fifth and usually the fourth hind tarsals completely white, remainder of the tarsi black ... 8.
   White markings of the tarsi, if present, not confined to the fourth and fifth hind tarsals ... 10.
8. Mesonotum with small, uniformly scattered scales ... *Ps. (Jan.) ferox.*
   Mesonotum with a broad, dark, central stripe; the sides light colored ... 9.
9. Fourth hind tarsal white; sides of mesonotum with yellowish scales ... *Ps. (Jan.) lutzi.*
   Fourth hind tarsal partly black; sides of mesonotum whitish ... *Ps. (Jan.) varipes.*
10. Hind tarsi without rings ... 11.
    Hind tarsi with rings, at least at base of first tarsal segments ... 17.
11. Prothoracic lobes silvered; a slender silvery line extending from between the eyes backwards to tip of scutellum; mid-femur with a white exterior spot beyond the middle ... *Aëdes (Conop.) leococelaenus.*
    Prothoracic lobes with lusterless scales, mid-femur without an isolated white spot ... 12.
12. Integument of mesonotum bright reddish yellow with a posterior pair of black spots and but very sparsely clothed with small yellow scales *Aëdes (Och.) fulvus.*

Integument of mesonotum dark brown and rather thoroughly covered with scales 13.

13. Mesonotum uniformly dark scaled (male with a slender white stripe) . *Aedes* (*Och.*) *nubilus*.

Mesonotum with white stripe .14.

14. Mesonotum with a slender white line; antenna slightly longer than proboscis 14.

Mesonotum with a broad stripe or patch of slight scales; antenna distinctly shorter than proboscis 16.

16. Mesonotal stripe creamy white in color; species of moderate size . *Aëdes* (*Och.*) *serratus*.

Mesonotal stripe bluish white; small species *Aëdes* (*Och.*) *hastatus*.

16. Mesonotum with a broad patch of white on anterior three-fifths (i. e., ending before wing bases) *Aëdes* (*Och.*) *scapularis*.

Mesonotum with a broad stripe extending as far back as the wing bases *Aedes* (*Och.*) *orinifer*.

17. All hind tarsals with rings 18.

Last three tarsals without rings 19.

18. Clypeus with white scales; a lyre-shaped marking on mesonotum *A.* (*Steg.*) *aegypti*.

Clypeus nude; anterior portion of mesonotum largely pale scaled *Aëdes* (*Taen.*) *fluviatilis*.

19. Mesonotum black and silvery 20.

Mesonotum black and golden 21.

20. Sides of mesonotum silvery; only the base of costa white scaled; palpi of male as long as proboscis *Aë.* (*Fin.*) *terrens*.

Female unknown, but male with anterior two-thirds of mesonotum entirely silvery; stem vein as well as costa white scaled; palpi distinctly shorter than proboscis *Aëdes* (*Fin.*) *argyrothorax*.

21. Mesonotum chiefly golden scaled *Aëdes* (*How.*) *fulvithorax*.

Mesonotum chiefly dark scaled with slender golden lines *Aëdes* (*How.*) *septemstriatus*.

KEY TO THE LARVAE OF PSOROPHORA.

1. Anterior corners of head squared; mouth brushes widely separated, prehensile; air-tube without a median enlargement. (Subgenus *Psorophora*) 2.

Anterior corners of head rounded; mouth brushes normal; air-tube enlarged more or less at the middle 4.

2. Air-tube pecten extending far beyond the middle, the tuft (consisting of a pair of long hairs) subapical *cilipes*.

Air-tube pecten only extending as far as the middle; the tuft located within the outer third 3.

3. Air-tube tuft multiple, shorter than the width of the tube *genumaculata*.

Air-tube tuft consisting of a single long hair *ciliata*.

4. Antenna distinctly longer than the width of the head (Subgenus *Janthinosoma*) *ferox*, *lutzii*, and *varipes*.

Antenna as long as or shorter than the width of the head (Subgenus *Grabhamia*) ..5.

5. Head as long as broad ...*cingulata*.
Head broader than long ...*confinnis*.

KEY TO THE LARVAE OF AËDES.

1. Antennal hair "tuft" (arising more or less at the middle of the shaft) consisting of a single hair (minute in stegomyia); anal segment broadly membraneous on ventral surface (container, artificial and natural, breeding species) ...2.
Antennal tuft consisting of two or more hairs (ground-water breeders). ...5.
2. Comb scales on eighth segment arranged in a single straight row of 8–12 scales (very rarely more, occasionally 18 in stegomyia) ...3.
Comb scales in a very irregular single row or several rows deep ...4.
3. Posterior margin of the sclerotized plate on the anal segment not spinose; the individual scales of the eighth segment comb with the basal (semi-transparent) portion more or less sole-shaped and with the apical (opaque) portion showing a strong apical and several lateral spines; the short hair tufts of thorax and body inconspicuous and with one to three hairs ...*aegypti*.
Posterior margin of the sclerotized anal plate distinctly spinose; comb scales with the semi-transparent portion oval and with a single spine; the short hair tufts of thorax and body conspicuous and composed of four to five hairs . ...*leucocelaenus*.
4. Comb scales in an irregular or double row, 12–20 in number; apical portion of the individual scales much longer than the basal, spatulate in shape, fringed but without spines; body with conspicuous stellate hairs ...*fulvithorax*.
Comb scales very numerous (40–50) arranged in a triangular patch, shape as in *fulvithorax;* body hairs similar but not as conspicuous (i. e., rather long and slender, or less spinose in structure) ...*terrens*.
5. Anal segment membraneous along ventral surface; basal portion of comb scales somewhat shorter than the coarsely fringed apical part *fluviatilis*.
Anal segment completely banded with sclerotin ...6.
6. Pecten of air-tube with detached teeth outwardly. ...*fulvus*.
Pecten consisting of evenly spaced teeth. ...7.
7. Air-tube nearly four times as long as wide; anal gills extraordinarily long ...*hastatus*.
Air-tube less than three times as long as wide; anal gills moderate or very short ...8.
8. Comb containing 10–12 teeth in a straight line ...*serratus*.
Comb with many (20 or more) in a triangular patch ...9.
9. Anal gills much longer than broad, body densely pilose ...*scapularis*.
Anal gills very short, nearly as long as broad; body moderately pilose ... *taeniorhynchus*.

Psorophora (Psorophora) ciliata Fabricius, 1794.

A very large, brown to very dark brown, species with moderarely shaggy legs and fairly distinct tarsal rings; distinguished from its allies by the median longitudinal stripe of brown scales.

This species has an extraordinarily wide geographical range, extending from southeastern Canada to about the middle of Argentina. The form found in the middle coast states of Brazil differs noticeably from specimens taken in Argentina and North America in being of a much darker color. It does not differ structurally. The species is apparently rare in the middle coast states. Our material consists of reared specimens, a small lot collected near the city of Bahia and another from the city of Pernambuco, both collected during the early part of the rainy season.

The species also occurs in the southeastern Brazilian states (Cesar Pinto).

Psorophora (Psorophora) cilipes (Fabricius), 1805.

A very large black species with a diffuse sprinkling of white scales on occiput and thorax; abdomen deep metallic violet blue, legs shaggy in appearance, the tarsi without white rings.

Evidently of strictly tropical distribution, Mexico to southern Brazil. Has been found in all three of the Brazilian coastal regions. Our material consists of specimens reared from larvae found near the city of Bahia during the early part of the rainy season.

Psorophora (Psorophora) genumaculata, Oswaldo Cruz, 1907

A very large shining black species with a widely separated pair of slender white lines on the mesonotum; legs entirely black, moderately shaggy; wings rather strongly infuscated.

The species was placed by Dyar (1928) as a synonym of *Psorophora lineata* (Humboldt). Recently Cesar Pinto (1930) has shown it to be specifically distinct. To date, it has been found only in Brazil and Misiones (Argentina) which adjoins Brazil. Adults have been collected on a few occasions but most of our material consists of reared specimens, the larvae of which were found associated with *ciliata* and *cilipes* larvae.

Psorophora (Janthinosoma) ferox (Humboldt), 1820.

A more or less woodland species; although only moderately common, it is probably the commonest species of the genus throughout its entire range, which is coextensive with that of *ciliata* (Canada to middle Argentina).

A fairly large species of a general dark reddish-brown color; occiput with bright yellow scales; the tarsi are black with the

exception of the fourth and fifth hind tarsals which are conspicuously white.

The species has been found in all three of the coastal regions of Brazil. Its principal season of abundance coincides with that of the early rainy season, but adults are found in small numbers throughout practically the rest of the year. They were, however, found in considerable abundance during midwinter in a locality (Ilhéos) some distance south of Bahia.

The larvae live in temporary rainpools having a grassy bottom, usually adjoining woodlands.

Psorophora (Janthinosoma) lutzii Theobald, 1901.

A rather rare, wide-ranging, tropical, principally woodland species, occurring from Mexico to Argentina. It is easily distinguished (except from *varipes*) by its rather dusky wings, by the broad dark stripe on the mesonotum, bordered by equally broad cream-colored areas, and by the dark hind tarsi tipped with white.

The larvae occur in temporary woodland pools, and after the first heavy rains of the rainy season the adults have a brief period of comparative abundance in their more favorable localities. The species appears to be exceedingly rare about the city of Bahia but has been seen on the wing in numbers near Estancia (Sergipe). It occurs in the three coastal regions of Brazil.

Psorophora (Janthinosoma) varipes Coquillet.

In Brazil, this species appears to be even less common than lutzii. It occurs in the southeastern states, but otherwise has practically the same distribution as lutzii. The two species are very similar in appearance, being distinguishable only by rather minor differences in color. Their habits are likewise similar. *P. varipes* has been captured in the middle coast and southeastern states of Brazil.

Psorophora (Grabhamia) cingulata (Fabricius), 1805.

Likewise a tropical woodland species (Central America to southern Brazil). Its mottled coloration, striped proboscis, and banded legs give it a superficial resemblance to species of the genus *Mansonia*, from which it may be easily distinguished by its narrow wing scales. The rather silvery cross-bands on the apical margins of the abdominal tergites constitute one of its most distinctive features.

P. cingulata appears to have a longer breeding season, at least in the vicinity of Bahia, than the other species of the genus. Despite its general abundance, larvae have been found on but

few occasions, and then usually in peculiar places, such as a tin can, hoof prints in mud, etc.

The species occurs in the three coastal regions of Brazil.

Psorophora (Grabhamia) confinnis, Lynch Arribalzaga, 1891.

This species is very similar to *P. cingulata* in appearance and habits, and practically coextensive with it. It differs from *P. Cingulata* in having the abdominal pale markings entirely dull, and the whitish scales intermixed with the black on the wings.

Has been recorded from Pará and the southeastern states, but apparently does not occur in the middle coastal states.

Aëdes (Stegomyia) aegypti (Linnaeus), 1762.

This species represents the only foreign element among the tropical species belonging to the subtribe Aëdini. It differs from all Brazilian species of *Aëdes* in many respects, in structure as well as in habits. (Dyar, 1918, has shown, on the basis of the genitalic structure of the male, that it is clearly of Old World origin.) The silvery markings of the head (scales on the clypeus) and thorax (lyre-shaped design on the mesonotum and the scutellum entirely with broad flat scales) easily set it apart from all other American Aëdines. Also, it is the only species not directly dependent upon rainfall, and therefore its breeding can continue practically undisturbed by natural influences, except in the case of cool temperatures and perhaps excessive dryness of atmosphere.

Probably exists along all the main highways of travel throughout Brazil, in the lower altitudes.

Aëdes (Howardina) fulvithorax (Lutz), 1904.

The principal habitat of the rather rare species of *Howardina*, is the countries and islands of the Caribbean. *Aë. fulvithorax* is the chief representative in Brazil. Its distribution is from the southern part of the country northward to Trinidad.

The golden mesonotum, dark abdomen with bright silvery spots on the sides of all the segments and on the dorsum of the fifth to seventh segments, and the single ring on the hind tarsi (base of the first segment) easily distinguish it.

The species lives only in well wooded areas. The larvae are found in rot holes in trees and in the open ends of broken bamboos. The females attack man rather readily; they have also been captured on animal bait (horses, etc.).

Probably occurs along the entire coast of Brazil wherever conditions are favorable, although as yet unrecorded from northern Brazil.

Aëdes (Howardina) septemstriatus Dyar and Knab, 1907.

Evidently a rare species and to date has been recorded only from Nicaragua and Panama.

Agrees with *fulvithorax* in the possession of but a single hind tarsal light ring, but is somewhat larger and more robust. The mesonotum is largely dark-scaled with a diffuse pattern of golden scales forming a very slender median line extending onto the scutellum, and three pairs of additional lines which are very indefinite.

Our collection contains a single female captured on animal bait (horse) at Pará, April, 1930 (N. C. Davis). Larvae have been found in Panama in tree holes.

Aëdes (Conopostegus) leucocelaenus Dyar and Shannon, 1925.

The subgenus *Conopostegus*, containing but a single species, is clearly intermediate between the subgenus *Finlaya* (*Aëdes*) and the genus *Haemagogus*. There has been considerable difference of opinion as to whether it should be located in *Haemagogus* or in *Aëdes*. Costa Lima (1930) has recently replaced the species in *Haemagogus*. The external characters of both sexes definitely place it in *Aedes*, although the genitalic structures of the male are rather definitely of the *Haemagogus* type. Inasmuch as it is preferable to base generic distinctions on characters possessed by both sexes rather than on the secondary sexual characters of the male, it is here proposed to keep the subgenus in *Aëdes*.

The species occurs from Panama to Argentina. In Brazil, it has, up to the present, been found only in the southeastern states. It is restricted to wooded areas, and the larvae live in tree holes. Costa Lima (ibid) gives photographs of the larval skins, from which the description of the species (as given in the larval key) is derived. The adults are known to attack man.

Aëdes (Finlaya) terrens (Walker), 1856.

Although one North American species of the subgenus *Finlaya* occurs as far north as New Hampshire and Montana, the species are chiefly of tropical distribution. *Aë. terrens* is the chief representative (at least in Brazil) and occurs from Mexico to southern Brazil.

The species is characterized by dark median stripe on the mesonotum, broadly silvered sides, and hind tarsi with two light rings, the first narrow and located at the base of the first segment, the second broad and involving the apex of the first and the base of the second segments.

We have reared two to three hundred adults and all but a very few males have the thoracic pattern as described above. The exceptions have the silvered areas of the thorax confluent,

thus agreeing with the description of *terrens* as given by Dyar (1928). The terminalia of the two forms, however, show no obvious differences, and Edwards, to whom specimens were sent, states that they constitute but a single species. He further suggests that *Aë. podographicus* Dyar and Knab (including *metoecopus* Dyar, already placed by Dyar as a synonym of *podographicus*) is but a variety of *terrens*. This would extend the distribution of *terrens* to Ecuador (type locality of *metoecopus*).

Although the larvae are found about Bahia in greater abundance than are the larvae of *Ae. fulvithorax*, the adults have not as yet been found in nature, although females of *fulvithorax* have been captured on a number of occasions while in the act of attacking man. This would indicate a difference of food habits. However, females of *terrens* kept in the laboratory feed on blood with about the same facility as *fulvithorax*.

Aë. terrens is also found in the southeastern states of Brazil, but it has not been recorded from Pará. The larvae are found in tree holes and bamboo joints.

Aëdes (Finlaya) argyrithorax Bonne and Bonne Wepster, 1920.

Up to the present time this species has been recorded only from Surinam ("We have two males, one captured near a tree hole at Geiersvlijt, the other in our house at Paramaribo." Bonne and Bonne Wepster, 1925).

We have five males, reared from larvae collected in tree holes. The larvae were not isolated.

Aëdes (Taeniorhynchus) taeniorhynchus Wiedemann, 1921

The subgenus *Taeniorhynchus* is widely distributed in North America, New Hampshire, and British Columbia southwards. In South America it extends as far south as Perú and Brazil.

Aë taeniorhynchus is the best known and most troublesome species of the genus *Aëdes* (excepting stegomyia) and extends along the Atlantic coast as far north as New York, and southward as far as southeastern Brazil.

The tinged proboscis and striped tarsi give it a close resemblance to certain species of *Mansonia*. It may be distinguished from the latter by the narrow wing scales, and from the similarly marked species of *Psorophora* by the basal position of the abdominal cross-bands on the segments.

Its principal season of abundance in the middle coast states of Brazil is during the early rainy season. During the dry season of summer a brood follows upon every shower sufficient to fill the rock pools.

Aëdes (Taeniorhynchus) fluviatilis (Lutz), 1904.

A comparatively little known species, recorded, up to the present, from Surinam, French Guiana, and Brazil. The larvae are found in the rock pools of stream beds, and breeding therefore is largely governed by rainfall. It attacks livestock and man, and when dwellings are located near the breeding sources it probably is troublesome.

Aëdes (Ochlerotatus) scapularis (Rondani), 1848.

The great majority of the American species of *Ochlerotatus* are of strictly north-temperate distribution. *Aë. scapularis*, the commonest tropical species, occurs from the West Indies to Argentina. The large patch of white scales on the anterior two-thirds of the mesonotum is sufficient to distinguish it from its Brazilian allies.

The larvae are found in grassy rain pools, and the species is the only one of the subgenus which breeds freely in suburban districts.

Aëdes (Ochlerotatus) serratus (Theobald), 1901.

Strictly tropical, Mexico to Bolivia. A fairly large species. easily distinguished from other Brazilian species of the group by the slender longitudinal line on the thorax.

The larvae are found in grassy rainpools near well wooded areas. The species occurs all along the Brazilian coast in regions suitable for its development.

Aedes (Ochlerotatus) hastatus Dyar.

Recorded to date only from Costa Rica and Panama. The adult is much smaller than *serratus* but otherwise greatly resembles this species. The larvae were found associated with those of *serratus* (Bahia, Brazil).

Aedes (Ochlerotatus) crinifer (Theobald), 1903.

All records for this species are based on specimens from Pará, southeastern Brazil, and northwestern Argentina. The adults have a fairly broad longitudinal stripe on the thorax, extending as far back as the wing bases. The larvae have been found in grassy rain-pools.

Aëdes (Ochlerotatus) nubilus (Theobald), 1903.

Extends from the West Indies to Argentina. The male has a slender thoracic stripe but the female differs from the other Brazilian species of the group in having the mesonotum entirely

dark scaled. The species appears to be strictly a forest inhabitant. Adults have been collected in Pará and in Bahia (Brazil).

The American subgenera and species of *Mansonia*, Blanchard.

The American fauna consists of three subgenera, *Coquillettidia* (North American), *Rhynchotaenia*, and *Mansonia* (tropical; subtropical in Argentina).

Subgenus COQUILLETTIDIA.

Proboscis with a broad median pale area; proepimeron uniformly clothed with scales and bearing about 12 setae; post-spiracular setae absent; mesepimeron with anterior four setae and a patch of scales; femora without a distinct subapical white ring but hind femur with a preapical black ring; basitarsus with a median white ring, the other rings located basally on the segments; mesonotal scales appressed; first abdominal tergite with a small, inconspicuous patch of dark scales; wing scales moderately broad, black and white intermixed; halteres pale.

Subgenus RHYNCHOTAENIA.

Proboscis dark, with a well defined median white ring and a smaller ring (distinct in all but *albicosta*) just before the tip; proepimeron with or without scales (when present consisting of a small patch) and with 2 to 6 setae; post-spiracular setae reduced in number and size (at least one or two always present); mesepimeron with one or two anterior setae and with or without a patch of white scales; femora with a subapical pale spot, or (usually) ring; tarsal white rings involving both ends of the segments; first abdominal segment with a very small median patch of dark scales; mesonotal scales appressed; halteres pale.

Subgenus MANSONIA.

Proboscis clothed with intermingled dark and pale scales, with or without a median white ring, and without the preapical white ring; proepimeron uniformly clothed with scattered scales and bearing 6 to 12 setae; post-spiracular setae well developed; mesepimeron with 3 to 5 anterior setae and a few scales intermixed with the upper setae; first abdominal tergite with a conspicuous patch of pale scales; mesonotal scales above wing bases semi-erect; femora with intermingled dark and pale scales and without a subapical white ring; tarsal white rings basal on the segments; wings scales broad, dark and pale intermixed; knobs of halteres dark.

KEY TO SPECIES.

1. Basitarsus with a median white ring (North American)........ *Man.* (*Coq.*) *perturbans* Wlk.
   Basitarsus without a median white ring........ 2.
2. Tarsal white rings involving both ends of the segments; femora with a subapical pale spot, or (usually) ring........ (*Rhynchotaenia*) 3.
   Tarsal white rings located basally on the segments; femora with intermingled dark and pale scales, without a distinctive pale spot........ (*Mansonia*) 10.

3. Mesonotum with only dark brown scales through the middle; white markings on thorax, legs, etc., with a distinct metallic silvery lustre......4.
   Mesonotum with a central pattern composed of golden or brassy scales; white markings without a silvery tinge......5.
4. Prothoracic lobes and sides of mesonotum with distinct silvery white spots......*lynchi*, sp. nov.
   Prothoracic lobes and sides of mesonotum with very inconspicuous patches of small brassy scales......*arribalzagae* Th.
5. Costa entirely dark scaled; hind tibia and usually the others without a series of light spots on outer surface......6.
   Costa white scaled at base (always ? see note on *fasciolatus*); all tibiae with a series of yellowish spots on outer surface; mesepimeron with a patch of white scales......8.
6. Wing scales entirely dark; fore and mid tibiae with a large white spot at outer third, hind tibiae with a white ring (Panama)......*nigricans* Coq.
   Wings with white markings, at least near the base......7.
7. First vein white scaled basally (i. e., a white line present at the wing base just behind the costa which covers the stem vein and continues onto the basal portion of the first vein); fore and mid tibiae with a slender pale line along outer surface, hind tibia with a large white spot at outer third; the upper sternopleural patch of white scales extending onto the mesepimeron......*albicosta* Chagas.
   First vein with a small white spot just beyond tip of stem vein; tibiae dark, save for the white spot at apex; mesepimeron without scales.... *chrysonotum*.[1]
8. Tibiae with a large spot at outer third; wing with scattered white scales anteriorly (Argentina)......*araozi* S. & Del P.
   Tibiae without this spot......9.
9. Wing with anterior portion inconspicuously mottled with patches of pale scales; fifth and sixth veins completely dark scaled...... *fasciolata* L. A.
   Wing with intermingled, rather broad black and white scales; present also on fifth and sixth veins......*justamansonia* Ch.
10. Proboscis with a fairly distinct short white ring beyond the middle; mesonotum without a definite pattern......11.
    Proboscis without this ring......12.
11. Palpi about one-third the length of proboscis; wing scales decidedly broad......*titillans* Wlk.
    Palpi about one-fourth the length of proboscis; wing scales moderately broad......*indubitans* D. & S.
12. Mesonotum covered with dull golden scales anteriorly, mainly dark on posterior third......*amazonensis* Th.
    Mesonotum as shown but with the anterior golden marking broadly divided by a dark stripe......*humeralis* D. & K.
    A large brownish species; the wings with broad scales only...... *pseudotitillans* Th.

[1]Costa Lima (1930) calls attention to the fact that *M. chrysonotum*, although placed as a synonym of *Man. amazonensis* by Dyar, is a distinct species.

Mansonia lynchi sp. nov.

Proboscis with a conspicuous white median ring, a much smaller one basad of the labellae; palpi one-fourth length of proboscis, tips silvery; upper lateral margins of occiput silvery scaled, those patches converging and passing forward between the eyes; remainder of occiput with sparse erect dark scales and setae. Prothoracic lobe with silvery patch above; mesonotum dark brown, three very small and inconspicuous patches of white scales on anterior margin, a small but very conspicuous patch of silvery scales above the mesothoracic spiracle, a similar patch close to base of wings and also on median scutellar lobe; two similar and widely separated patches on sternopleura and a large one on mesopleura; mesopleura with two anterior median setae; all femora dark, with silvery apices and a rather small patch on upper side beyond middle; tibiae dark, the front pair tipped with silver; fore tarsi with two incomplete rings; mid tarsi with spot at base of first and at base of second segments; hind tarsi with a fairly large spot at base of first segment, a ring at base of the second, third, and fourth segments, the fifth entirely pale (shading from silver to cream yellow); abdomen dark above, silvery spots on side of tergites, also on sternites; halteres partly silvery; wing with a single silvery spot, located just beyond tip of "stem" vein.

Mansonia arribalzagae Th.

Differs from *M. lynchi* as follows:

General color more reddish brown; occiput with small, rather widely scattered (more grouped at apex) brassy scales; the silvery patches on mesonotum, prothoracic lobes, and scutellum replaced by much less conspicuous patches of brassy scales, except that the patch near the wing base is black; a dark yellow ring on fore femur beyond the middle; legs otherwise very similar; wing without the silvery spot.

Figures of the terminalia of both species are shown on plate 9. The principal differences are shown by structure of the phallosome and of the clasper.

Types (male holotype, female allotype) to be deposited in the U. S. National Museum. Paratypes: One male, one female. Type locality: Pará, Brazil (April, 1930, hand captures in woods, N. C. Davis collector).

Numerous specimens of *M. arribalzagia* were collected at the same time.

I am indebted to Mr. F. W. Edwards for comparing a description of the new species with the type of *M. arribalzaga* (in the British Museum) and confirming the fact that it is a new species.

V. NOTE ON THE "SPECIES" OF CHAGASIA (*Anophelini*).

Three species have been described under the genus *Chagasia: C. fajardoi* (Lutz), 1904, *C. bonneae* Root, 1923, and *C. bathanus* Dyar, 1928.

C. bonneae was distinguished from *fajardoi* chiefly on the basis

of apparently highly satisactory characters present in the pupa and male genitalia. *C. bathanus* was distinguished from *bonneae* chiefly by certain color differences in the adult, and by pupal characters. The known distribution of the three forms would, ordinarily, likewise indicate them to be distinct, southeastern Brazil, Surinam, and Panama respectively.

During a trip into the interior of the state of Bahia (Bomfim), a fairly mountainous region with swift flowing streams, Dr. N. C. Davis and the writer found a number of larvae, pupae, and adults (the latter attacking horses at dusk).

Both types of pupae as described, for *fajardoi* (without a flap-like projection on the breathing trumpet) and for *bonneae* with a flap-like projection), were found. However, each type of pupa produced both types of male, i. e., males with but two spines on the sidepiece (*fajardoi*) and males with about ten spines (as described for *bonneae*).

Admittedly the situation is most unusual, i. e., to have two apparently distinct types of pupae and two equally distinct types of adults in a given species from the same locality. However, we are forced to the conclusion that *C. fajardoi* and *C. bonneae* are but a single species. This being the case, it is highly probable that *C. bathanus*, which differs but slightly from *bonneae*, is likewise a synonym of *fajardoi*.

VI. THE SUBGENUS STETHOMYIA (*Anophelini*).

The group which is here termed a subgenus of the Anophelini, presents a number of remarkable features when compared with the remainder of the American fauna of the tribe, indicating that it constitutes a very distinct stock. To emphasize this in the adult stage, a special dicotomy has been included in the key to the tribes and genera given above. Even more striking features are present in the larvae and male genitalia (Shannon and Davis, 1930). If the American fauna only were considered, it should be accorded generic rank. Several Old World species, however, possess the peculiar larval characteristics of *Stethomyia*, as well as the more typical *Anopheles* characters. Should they be found to be definitely allied to *Stethomyia*, the group will, in all probability, have to retain its subgeneric rank.

THE SPECIES OF STETHOMYIA (*Anopheles*).

Until recently it has been thought that *Stethomyia* contained but a single American species. Theobald figured the terminalia of the type species, but apparently, owing chiefly to lack of material, no further study was made of these organs until Bonne and Bonne-Wepster described them in 1926. They named the material before them *S. nimba* Theobald, but it now appears that their specimens belong to a different species.

Shannon and Davis (1930) described also under *S. nimba* Th., the larvae and male of a species found in Bahia, Brazil. The characteristics of the terminalia of the Bahian specimens are similar to those shown in the figure given by Bonne and Bonne-Wepster.

Edwards (1930), basing his study on material from Venezuela and Panama, states: "The Venezuelan specimen agrees with Theobald's rather rough figure of his type from Brazil; the Panama specimen agrees rather closely with the figure given by Bonne and Bonne-Wepster. These two specimens show such marked differences that they almost certainly represent distinct varieties, if not species." To the Panama specimen he gives the name *A. nimbus*, var. *kompi*.

In view of the abundance of our material from Bahia, which as stated above agrees with the figure given by Bonne and Bonne-Wepster, we can confirm with certainty that the material studied by Edwards represents two distinct species.

This year, Davis collected several females of *Stethomyia*, in Pará, the type locality of *S. nimba*. We were able to distinguish these specimens from the Bahian form on the basis of external characters and considered them to be specifically distinct. However, we have recently obtained in the vicinity of Bahia, several females and a single male (all hand captures), which are quite indistinguishable from the specimens from Pará. The terminalia of the male are radically distinct from our common species, presumably *S. kompi*, but although they closely approach the type possessed by *S. nimba*, as illustrated in Edwards' publication, there are several well-marked differences which serve to distinguish them. It is therefore proposed to describe the species as new.

It is of considerable interest to note that the photographs given by Costa Lima (1929) illustrating the terminalia of *Stethomyia* (very probably from Brazil but the exact source of origin is unknown) appear to represent yet another species. It is impossible to distinguish details, but from general appearances it approaches *S. nimba* as described by Edwards.

Stethomyia lewisi, new species.

Adults: probably indistinguishable from *S. nimba* on the basis of adult characters (at least from the specimens we have from Pará which may be the true *nimba*). However, it is fairly easily distinguishable from *S. kompi* by the long silvery-white scale-like setae which project far forward and overhang the large basal antennal joints (in *kompi* these setae are normal and not grouped together, the white spot at the vertex of the head being composed chiefly of scales); by the three white lines of the mesonotum being strongly defined (the lateral ones in *kompi* are rather indefinite); and by the presence of one or two prealar setae (absent in *kompi*).

Male terminalia: Similar to *S. nimba* in having the strong spine remote from the base of the side-piece (it being at the same level as the internal spine) and in having the clasper distinctly longer than the side-piece. They differ from the *nimba* type chiefly in the structure of the claspette. Plate 10 shows figures of the three species whereby direct comparisons may be made.

The obvious differences are: The more elongate condition of the larger arm of the claspette (short and broad in *nimbus*), the elongate and trough-like intermediate arm (broad with an inner point in *nimbus*), and the shorter and stouter spine of the inner arm.

Figure 2 gives the normal dorsal aspect of the left processes of the claspette and the internal lateral aspect of the right side.

Costa Lima speaks of the ostrich-head-like appearance of the large arms of the claspette (the outline is reproduced in figure 12). These bear a general resemblance to the corresponding arms in *nimbus* as illustrated by Edwards (reproduced in figures 10 and 11).

Male holotype and female allotype to be deposited in the U. S. National Museum. One female paratype.

Type locality: Rio Cururipe (near the city of Salvador), Bahia, Brazil.

Named in honor of Dr. Paul A. Lewis.

VII. THE LARVA OF SABETHES CYANEUS (Fabricius), 1805.

Dyar (1928) states that a specimen of *Sabethes cyaneus* was bred from a tree-hole in Panama, but no larvae were obtained.

The only larva known for the genus is that of *S. bipartipes* Dyar and Knab. This is described as having the air-tube conically tapered, densely spicular, with a few weak hairs; lateral comb on a narrow transverse plate. Found in tree holes and fallen banana leaves.

Davis, while at Pará (April, 1930), obtained larvae of *cyaneus* from bamboos from which a male and three females were reared.

The larva differs from that of *bipartipes* chiefly in having the comb-scales separated.

It is of interest to note that, although the genus *Sabethes* apparently has been derived from *Sabethoides*, the larvae of the two *Sabethes* now known in the larval stage lack the dorsal hooks on the seventh segment, which, as far as is known, are unique to the genus *Sabethoides*.

Plate 11 gives the larval characters (figures 1, 2 and 3) and the genitalic characters (figures 4–7).

Acknowledgment.

The writer is pleased to take this opportunity to thank Dr. Nelson C. Davis for his assistance in the course of this work.

REFERENCES.

BAUER, J. H.
1928. The transmission of yellow fever by mosquitoes other than *Aedes aegypti*. Amer. Jour. Trop. Med., 8: 261–282.

BONNE, C., and BONNE-WEPSTER, J.
1925. Mosquitoes of Surinam, a study on Neo-tropical mosquitoes. Royal Col. Inst. Amsterdam, no. 21, Dept. Trop. Hyg., no. 13, 558 p.

DA COSTA LIMA, A.
1929. Sobre algumas especies de *Mansonia* encontradas no Brazil Supp. Inst. Osw. Cruz, no. 12, p. 297–300.

DA COSTA LIMA, A.
1930. Sobre os mosquitos que se criam em buracos de arvores. Mem. Inst. Osw. Cruz., 23: 255–260.

DAVIS, N. C., and SHANNON, R. C.
1929. Studies on yellow fever in South America. V. Transmission experiments with certain species of *Culex* and *Aëdes*. Jour. Exp. Med., 50: 803–808.

DYAR, H. G.
1918. The male genitalia of Aëdes as indicative of natural affinities. Ins. Ins. Mens., 6: 72–73.

DYAR, H. G.
1928. The mosquitoes of the Americas. Carnegie Inst. Washn. Pub. no. 387, 616 p.

DYAR, H. G., and SHANNON, R. C.
1924. The subfamilies, tribes and genera of American Culicidae. Jour. Wash. Acad. Sci., 15: 472–486.

EDWARDS, F. W.
1921. A revision of the mosquitoes of the Palaeartic Region. Bull. Ent. Res. 12: 263–351.

EDWARDS, F. W.
1930. Mosquito Notes IX. The genera and subgenera of Anophelini. Bull. Ent. Res., 21, 287–289.

HOWARD, L. O., DYAR, H. G., and KNAB, F.
1912. The mosquitoes of North and Central America and the West Indies. Carnegie Inst. Wash. Pub., no. 159, vol. I.

KNAB, F.
1907. The swarming of *Anopheles punctipennis* Say. Psyche, February, 1907 (vide Howard, Dyar and Knab, Vol. I, 1912, p. 126).

PHILIP, C. P.
1929. Preliminary report of further tests with yellow fever transmission by mosquitoes other than *Aëdes aegypti*. Am. Jour. Trop. Med., 9: 267–269.

PHILIP, C. P.
1930. Studies on the transmission of experimental yellow fever by mosquitoes other than *Aëdes*. Am. Jour. Trop. Med., 10: 1–16.

PHILIP, C. P.
1930. Experimental transmission of yellow fever by mosquitoes. Science, 71: 614–615.

Root, F. M.
1927. Studies on Brazilian mosquitoes. II. *Chagasia fajardoi.* Amer. Journ. Hygiene, 7: 470–480.

Shannon, R. C. and Davis, N. C.
1930. Observations on the Anophelini of Bahia, Brazil. Ann. Ent. Soc. America, 23: 467–492, Plates I–VII.

List of Plates and Figures.

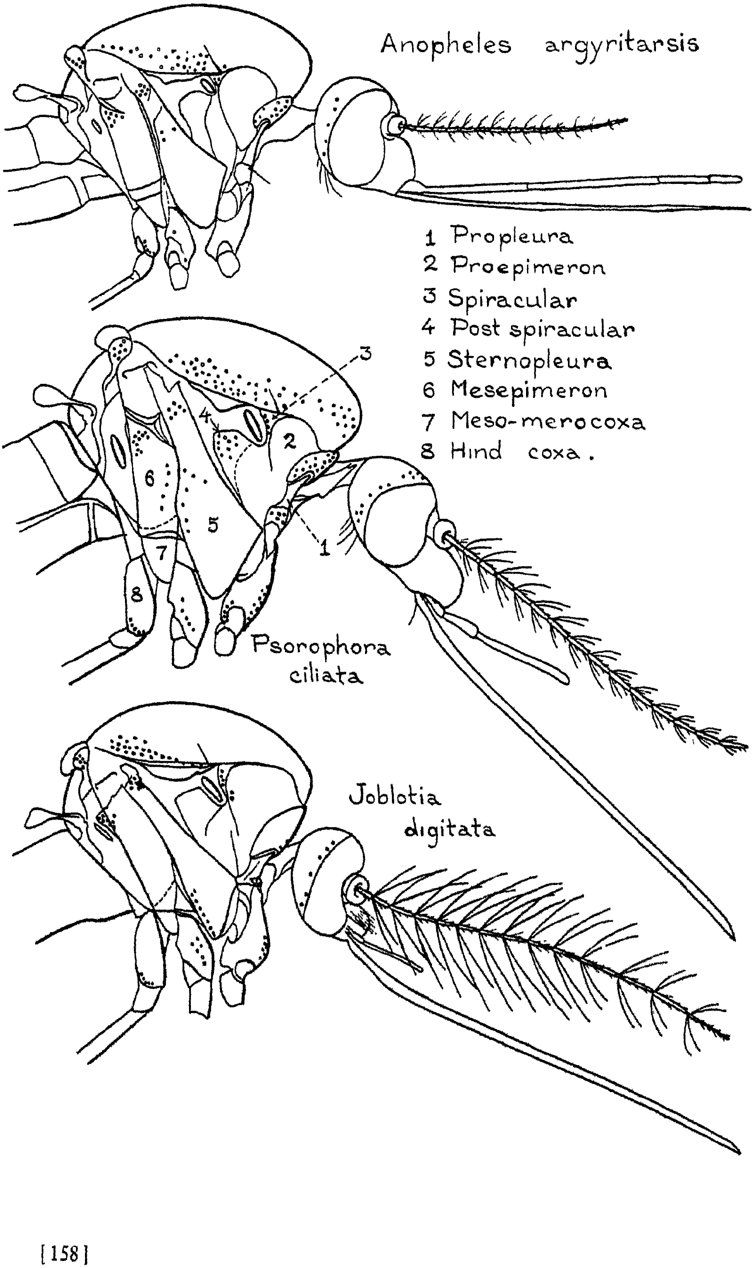
Plates 5, 6, and 7. Figures of representatives of various genera to show the general form of the head, development of clypeus, distribution of thoracic setae, size of the hind coxa and its relation to the meso-merocoxa. Also the wing venation of *Uranotaenia geometrica.*

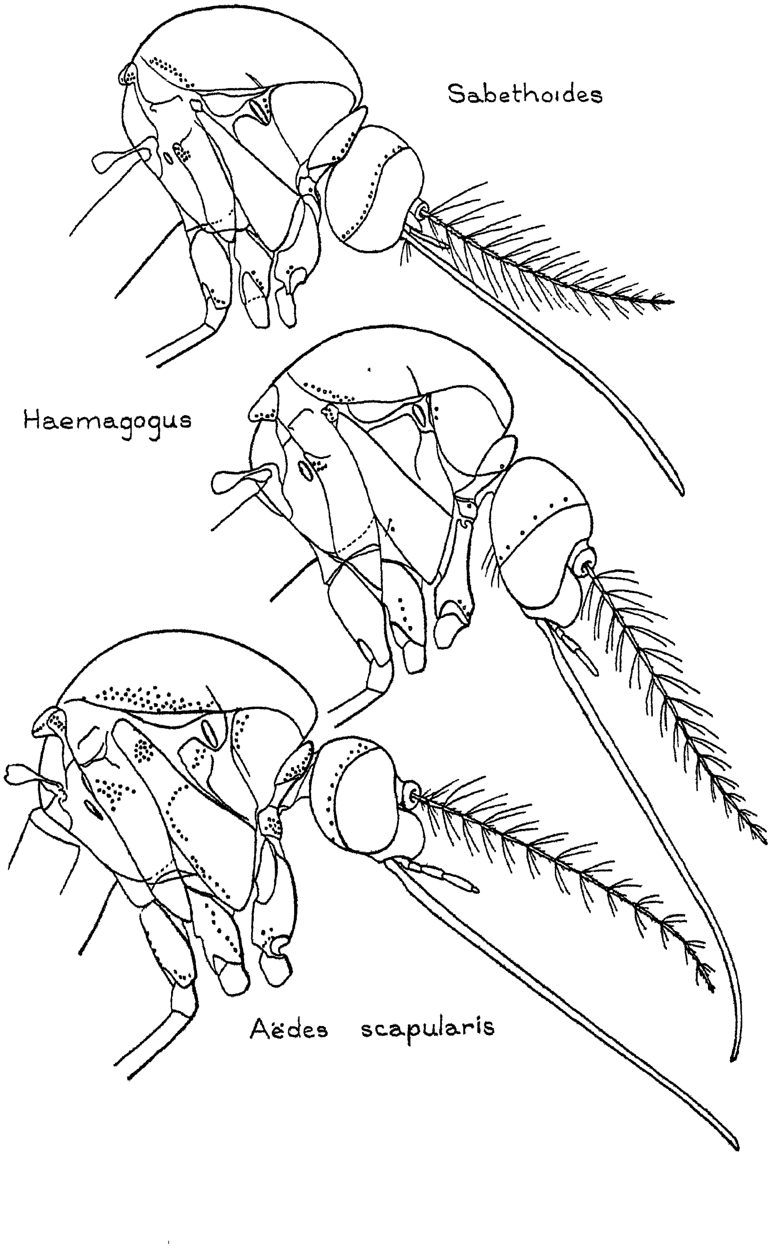
Plate 8. Wings of *Mansonia fasciolata* and *Aëdes taeniorhynchus*, to show the development of the scales on the sixth vein. Also the comb scales of the larvae of various species of *Aëdes.*

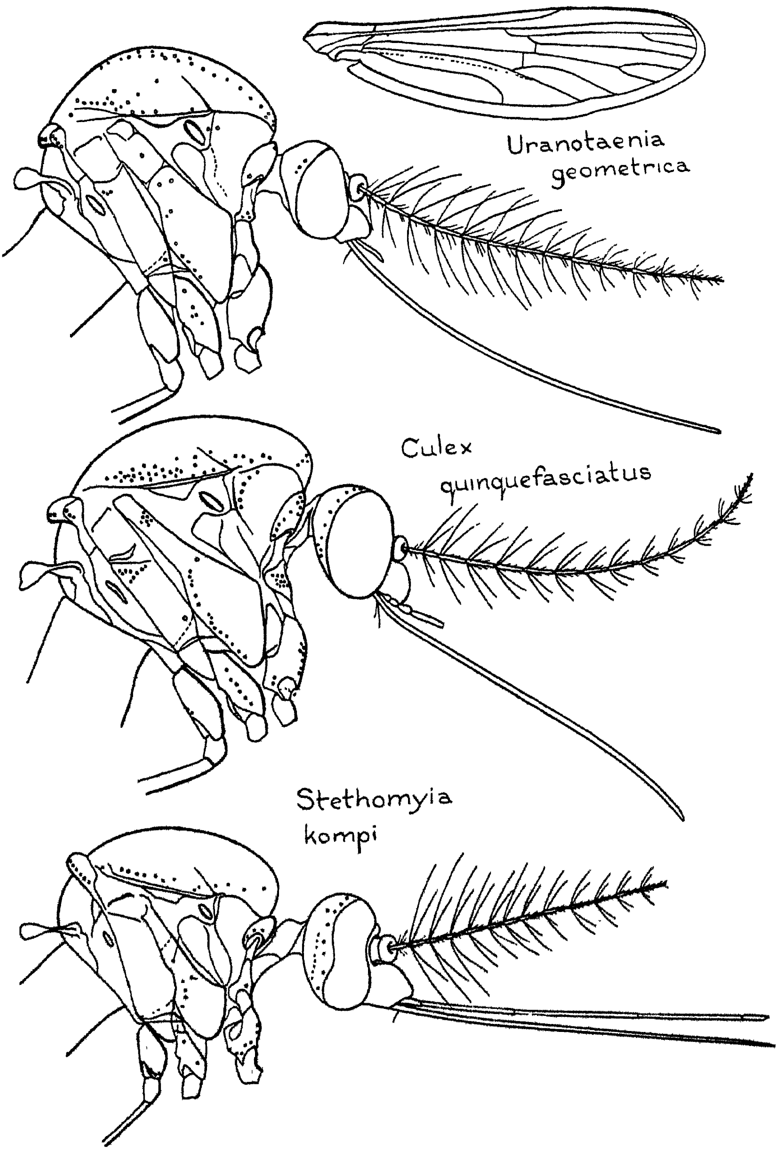
Plate 9. Terminalia of *Mansonia lynchi* n. sp. and *M. arribalzagae* Th.

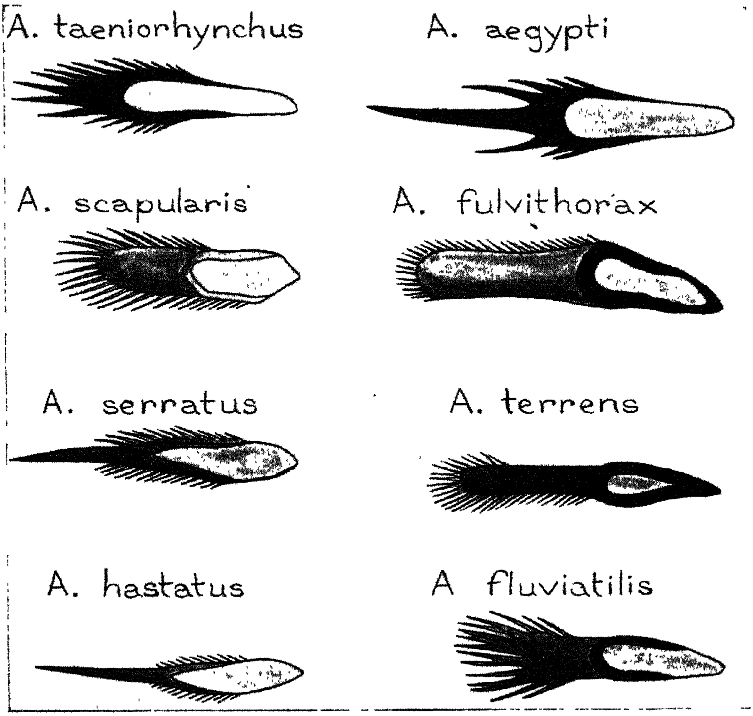
Plate 10. Comparison of the terminalia of the species of *Stethomyia* (*Anopheles*).

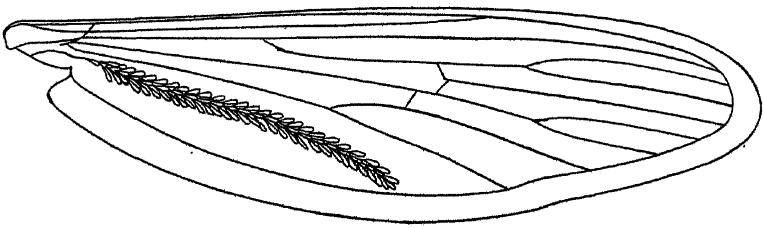
Plate 11. Larval and terminalia details of *Sabethes cyaneus.*


Anopheles argyritarsis
1 Propleura
2 Proepimeron
3 Spiracular
4 Post spiracular
5 Sternopleura
6 Mesepimeron
7 Meso-merocoxa
8 Hind coxa.
3
4
2
6
5
1
7
8
Psorophora ciliata
Joblotia digitata

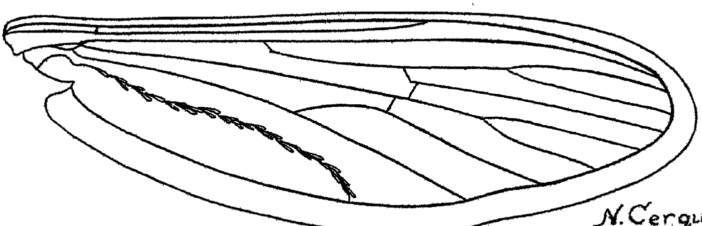

Sabethoides
Haemagogus
Aëdes scapularis


Uranotaenia
geometrica
Culex
quinquefasciatus
Stethomyia
kompi
N. Cerqueira.





Mansonia fasciolata

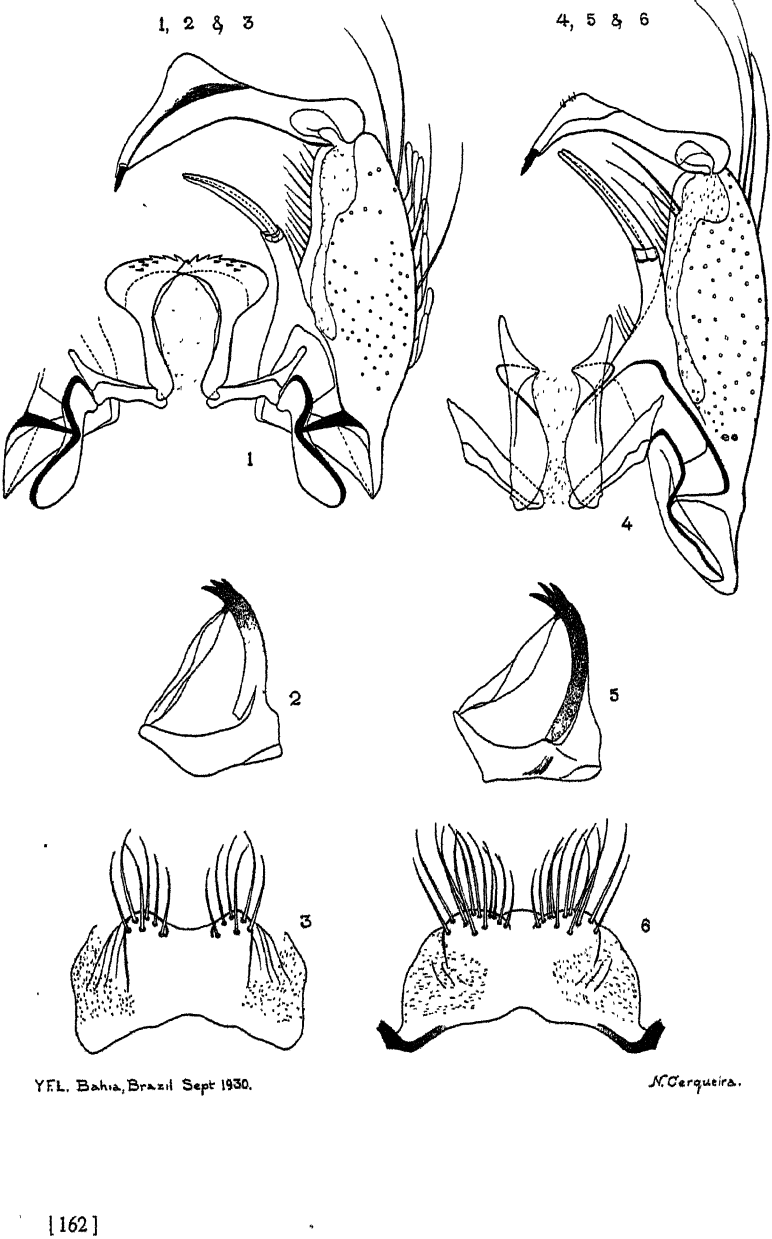


N. Cerqueira.

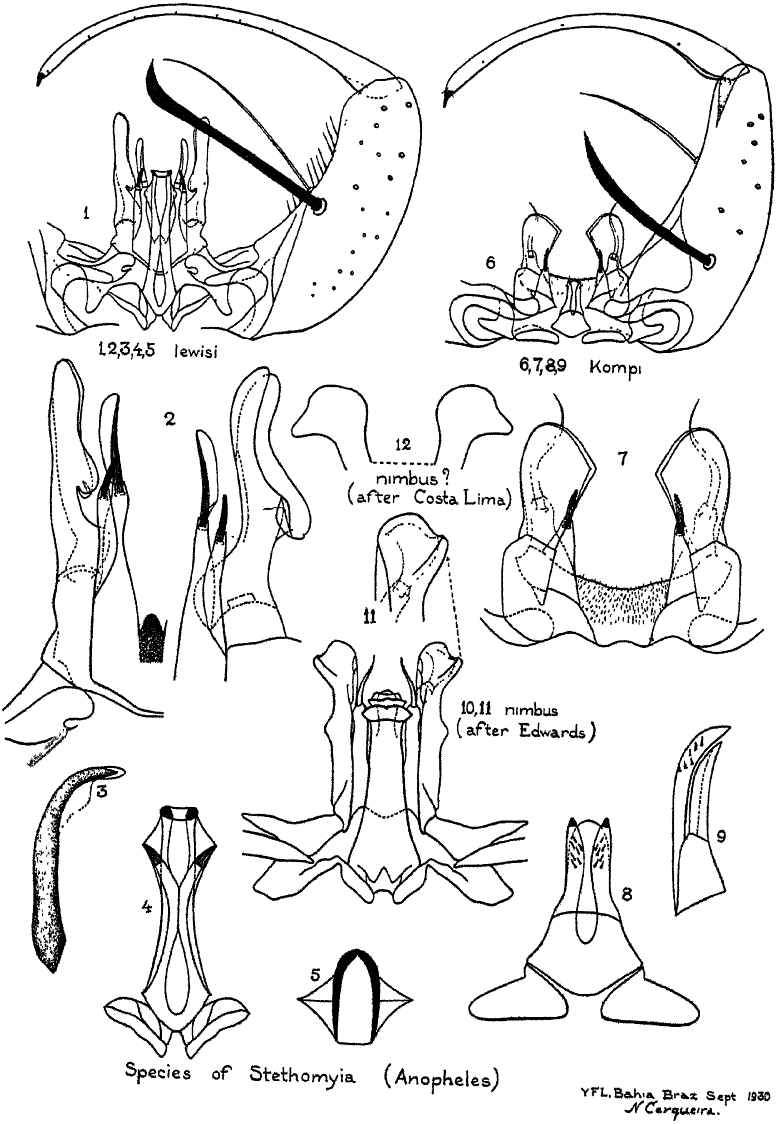
Aëdes taeniorhynchus

Mansonia lynchi Shn. M arribalzagae Th.

1, 2 & 3 4, 5 & 6

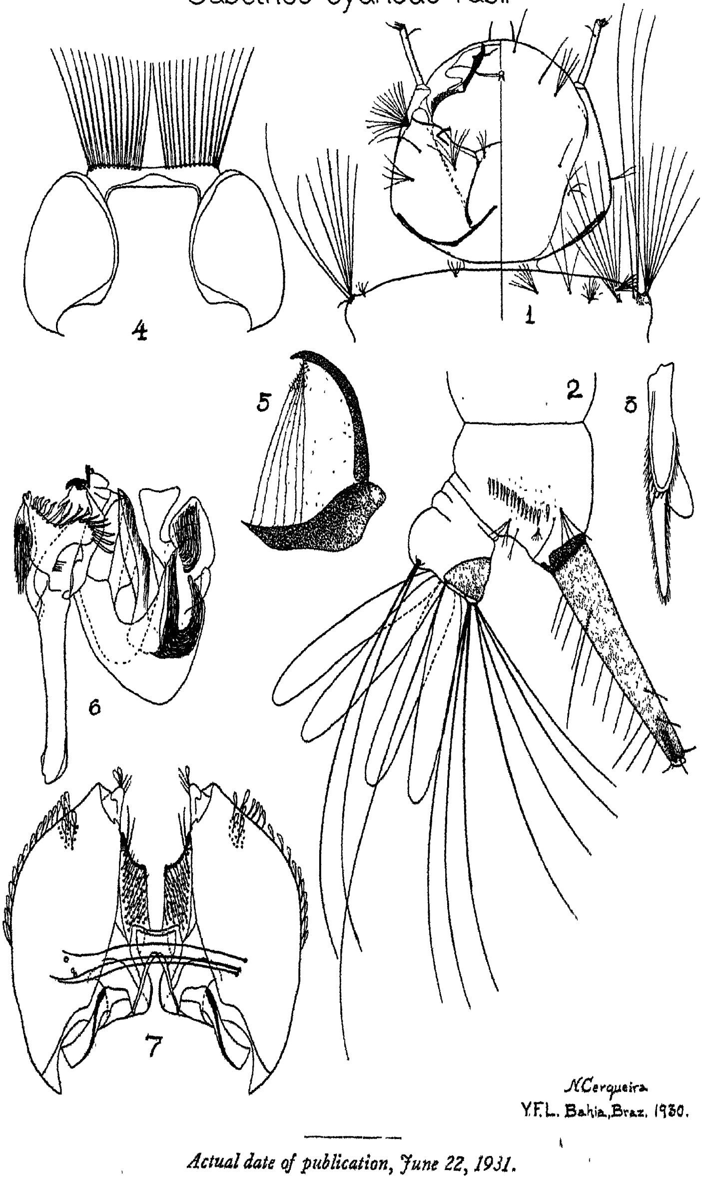


Y.F.L. Bahia, Brazil Sept 1930. N. Cerqueira.



Species of Stethomyia (Anopheles)

Sabethes cyaneus Fabr.



Actual date of publication, June 22, 1931.

PROCEEDINGS OF THE
ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 33 OCTOBER, 1931 No. 7

A NEW SPECIES OF SAWFLY OF THE SUBGENUS ZADIPRION WITH A DESCRIPTION OF THE MALE OF N. (Z.) VALLICOLA ROH. AND A KEY TO THE SPECIES OF THE SUBGENUS.

By WILLIAM MIDDLETON,
Entomologist, Branch of Forest Insect Investigations, Bureau of Entomology, U. S. Department of Agriculture

The following descriptions are of a new species of the subgenus *Zadiprion* of the genus *Neodiprion*,[1] (*Neodiprion* (*Zadiprion*) *rohweri*) and of the male of *Neodiprion* (*Zadiprion*) *vallicola* Roh., respectively.

The new species is a very interesting one and differs in color quite strikingly from the other three species assigned to this subgenus, viz, *N.* (*Z.*) *grandis* (Roh.), *N.* (*Z.*) *townsendi* (Ckll.), and *N.* (*Z.*) *vallicola* Roh. These differences include the particular color markings which Rohwer used as part of his characterization of the subgenus. This sawfly, however, is distinctly congeneric with those mentioned on structural characters and tends thus to support the taxonomic value of the group Rohwer treated as the subgenus *Zadiprion*. The stability of the morphological characteristics of the group indicate that it is a true biological division of this subfamily, easily recognized regardless of the rank given to it. This species was collected by Dr. H. E. Burke of the U. S. Bureau of Entomology, feeding on pinyon pines in California and Colorado.

Neodiprion (Zadiprion) vallicola Roh., was described by Rohwer from a single female from Meadow Valley, Mexico. During 1930, workers of the Mexican Plant Protection Service collected sawfly larvae feeding on pine in Michoacan and reared the adults. Four of these, two females and two males, were sent to Mr. Rohwer for identification by Dr. A. M. Dampf and were recognized by Rohwer as his species *N.* (*Z.*) *vallicola*. Since the male of this species is undescribed, it seems desirable to include a description of it herewith.

[1]Subfamily Diprionianae, Family Tenthredinidae, Superfamily Tenthredinoidea, Suborder Chalastogastra, Order Hymenoptera.

KEY TO THE SPECIES OF THE SUBGENUS ZADIPRION.

Inasmuch as the subgenus *Zadiprion* contains only four species, and since these are represented in the collection of the U. S. National Museum by female types in all four species and by males in three species, the following key to the subgenus is given.

1. Males: Antennal joints 4 to at least 18 strongly biramose with the basal external rami longer than the length of the postocellar area; the terminal four or five joints of the antennae uniramose or not ramose and swollen; the abdomen keeled middorsally and with the dorsal surface of the tergites finely granular or finely rugosely striate; prevailing color for the entire body black; ocellocular line as long or longer than the postocellar line.......................................2.
   Females: Antennal joints 4 to 18 not strongly biramose, rami no longer than the joints; the abdomen keeled middorsally but not always strongly keeled; ocellocular line as long or longer than the postocellar line.......................................4.
2. Pleural regions of the abdominal tergites with yellow spots; prescutum and scutum densely punctured and not highly polished ....3.
   Pleural regions of the abdominal tergites without yellow spots; prescutum and scutum highly polished and with fine, well separated punctures.......................................*rohweri n. sp.*
3. Basal plates, clypeus, supraclypeal area, and first parapteron yellow... *grandis* (Roh.)
   Basal plates, clypeus, supraclypeal area, and first parapteron black.... *vallicola* Roh.
4. Abdominal tergites distinctly, finely, rugosely striate or finely granular in texture; at least some tergites black; the thorax largely brown.................5.
   Abdominal tergites polished, if at all granular or rugosely striate in texture it is difficult to determine; entire abdomen, thorax, and head yellowish-green.......................................*rohweri* n. sp.
5. Mesoscutellum not densely punctured, few punctures in the anterior portion.......................................*grandis* (Roh.)
   Mesoscutellum densely punctured over entire surface.................6.
6. Mesoscutellum mostly black; basal plates with black and very little yellow.......................................*vallicola* Roh.
   Mesoscutellum mostly yellow, brown posteriorly; basal plates largely yellow.......................................*townsendi* (Ckll.)

Neodiprion (Zadiprion) rohweri, n. sp.

This sawfly is distinctly a species of the subgenus *Zadiprion* of Rohwer. It agrees nicely with the other species of *Zadiprion* in structure, including the structural characters used by Rohwer in erecting and defining the subgenus. It differs remarkably in coloration, however, by wanting the yellow-banded black abdominal tergum in the female and the yellow-spotted black abdominal tergum in the male. It is evident also that the pale

green color of the specimens is not due to death in immaturity, since in a letter discussing this, Dr. H. E. Burke, who collected and reared the material, states: "All of the specimens were reared in the laboratory and kept on pine foliage until they died. I think that their present color is the mature color."

Female.—Body length 8.5 to 10 mm.; head width 2.9 to 3.5 mm.; height about 2.3 to 3 mm. Head pale yellowish green except for the compound eyes, which are blackish, and where otherwise noted; antennae of 22 (both right and left) or 23 joints, noticeably longer than width of head, at least 4 mm. long, joint 3 longer than 4 or 5 but not twice the length of joint 2, and shorter than joint 1; apical half of mandibles deep blackish-brown, basal half pale yellowish green and with many pale hairs on exterior part of the base; labrum pale yellowish-green, shining, with long pale hairs, especially at the apex, where they form a fringe, width about twice median length, anterior margin rounded, about parallel with mandible curve but not symmetrical, the right side somewhat larger, with an apical dent; clypeus but little more polished than labrum, pale yellow with long pale hairs, with very few punctures and hairs and almost the entire clypeus convex in its slope toward the labrum, thus lacking the transversely depressed and highly polished apical clypeal area of the subgenus *Neodiprion*, anterior margin broadly and shallowly emarginate for about the width of the labrum; supraclypeal area bulging, usually faintly divided longitudinally and with a deep groove separating it from the adjacent portion of the antennal socket; lower and interior portion of antennal socket ring raised abruptly; face shining, with but very few punctures or hairs, mostly pale yellowish green, more yellowish between ocelli and antennae, with small black triangular marks interiorly and dorsad of the lateral ocelli and with an inverted black V above the median ocellus; ocellar area not very much raised and not well defined; postocellar line distinct and shorter than the ocellocular line; postocellar area shining and with a few punctures, not distinctly defined laterally, neither prominent nor divided, and longer than half its width; antennae brown, basal three joints very slightly lighter with yellowish green.

Thorax: Pronotum pale yellowish green, shining, with sparse, indistinct, shallow punctures and few hairs; proepisternum pale yellowish green, shining, with sparse indistinct punctures and few hairs; prescutum pale yellowish green, shining, almost hairless, with a few indistinct punctures of two sizes, those in the anterior median portion more regular, lateral and median longitudinal sutures distinct, frequently darkened, especially the latter; tegulae yellowish green and distinctly but finely punctured; scutum pale yellowish green, shining, with few punctures of two sizes, the smaller ones more abundant and rather evenly dispersed, distinctly separated from the scutellar plate by an obtuse inverted V-shaped suture, the anterior three-fifths of which on each side is deeply impressed to form a groove and is blackened; mesoscutellar plate distinctly broader than long, concolorous with the rest of thorax and head, with coarse punctures, especially posteriorly and at the sides, anterior angle obtuse, posterior margin truncate; lateral arms of scutellum pale yellowish green; first parapteron pale yellowish green, with a few distinct punctures and a few hairs; mesepisternum pale yellowish green, lateral aspect densely and coarsely punctured, ventral

aspect more finely punctured; metanotum pale yellowish green, the metascutellar plate with a distinct suture separating it from the rest of the metanotum and appearing finely rugulose towards the center; legs pale yellowish green with apex of tibiae and tarsi brownish; wings hyaline, the venation blackish, most of costa and stigma yellowish, cross vein usually wanting in the anal cell.

Abdomen pale yellowish green, including the basal plates, with the posterior lateral expansion of the ninth tergite and the apical portion of the sheath somewhat brownish; last distinct sternite completely divided longitudinally by a membranous wedge-shaped area extending cephalad from the base of the sheath; rods and pads of the apical portion of the sheath very thick, practically touching, almost entirely obscuring the median ridges, pads as long as the rods and together shorter than the large plates of the basal portion of the sheath which are rolled in on their interior ventral margin to form a kind of groove.

Male.—Body length 8 mm.; head width 2.6 mm., height 2 mm. Head black except where otherwise noted; antennae of 24 or 25 joints, the apical five uniramose and swollen, the basal joint of the five somewhat divided, antennal joints 4 to 19 distinctly biramose, the rami shortening towards the apex of the antenna and the exterior rami longer than the interior ones, joint 3 uniramose, the prong broadened basad of the middle; mandible brown at apex, black at base and with a yellow area before the apical brown, with yellow hairs exteriorly at the base; labrum yellow and shining, with long yellow hairs projecting ventrally and forming a fringe around apical margin; apical margin curved, somewhat more full and rounded on the right side and without a median dent; clypeus shallowly emarginate for the width of the labrum, posterior margin parallel and well defined for the width of the supraclypeal area, usually black at the sides and center but with a pale mark diverging from the supra-clypeal area towards the lateral margin of the labrum at each side, the entire clypeus convex and sparsely and irregularly punctured; supraclypeal area convex, rather evenly punctured, black, distinctly separated by a groove from the ventral interior margins of the antennal socket; interior and lower margins of antennal sockets raised, area between antennal sockets rugose; upper portion of face glistening, rather evenly punctured, and with a few hairs; face between lower halves of compound eyes with many long yellow hairs; ocellar area punctured and elevated, depression defining it laterally not abrupt and distinctly divided by a low transverse ridge opposite the upper third of the compound eye; postocellar line a distinct, deeply impressed groove, shorter than the ocellocular line; postocellar area bulging, glistening, and sparsely punctured but not distinctly defined at the sides and not divided, punctures of two sizes, the majority smaller than those on the face; head with a yellow spot between compound eye and postocellar area.

Thorax black except as otherwise noted; pronotum black with yellow along the margins, especially the dorsal and lateral margins, coarsely and densely punctured and with dense, long, pale hairs; prescutum shining, evenly and finely punctured, and with a few coarse punctures posteriorly, hairs not prominent; scutum similar to prescutum; mesoscutellar plate coarsely and densely punctured, the punctures of at least two sizes; first parapteron yellowish and punctured; mesepisternum evenly and coarsely punctured, less coarsely on the venter, and with long pale hair; metanotum black, plate of metascutellum densely coarsely punctured, and with long pale hairs; legs with coxae, at least

part of the trochanters, and the basal under half of the femora black, rest of legs pale yellow, claws long, the inner tooth extremely short, about half way down the claw and separated from the apical hook by more than the length of the apical hook; wings hyaline, almost perfectly clear, slightly iridescent, veins dark smoky but not black, costa and stigma nearly clear.

Abdomen black except apical portion of hypandrium, genitalia, and the ninth tergite, which are yellowish green; basal plates elongated, granular or rugosely finely striate at the sides and with large close punctures immediately behind the metascutellum and the cenchri; remaining tergites finely granular or finely rugosely striate and keeled middorsally; sternites and hypandrium and pleural portion of the tergites evenly and coarsely punctured, and finely haired.

Type locality.—Swartout Valley, San Bernardino, Calif.

Paratype locality.—Mesa Verde National Park, Colo.

Described from 6 (1 type) females and 3 (1 allotype) males from the type locality and 17 females from the paratype locality. One imperfect male came from the paratype locality and was reared with the females, but since it was not entirely male in its characters and was abnormal in its development, it was not placed in the paratype series. This material was all reared by Dr. H. E. Burke from larvae feeding on pinyon pine (*Pinus monophylla*) at Swartout Valley, Calif., and *Pinus edulis* at Mesa Verde, Colo., and is recorded under Bureau of Entomology Hopk. U. S. note numbers as follows:

Swartout Valley, San Bernardino, Calif. Hopk. U. S. 17915a–a2–a6–a6a.

Mesa Verde National Park, Colo. Hopk. U. S. 18075a–a3–a4–a5.

Type, allotype, and *paratypes.*—Cat. No. 43467 U. S. National Museum, all deposited in the U. S. National Museum collection, Washington, D. C.

This species is named in honor of S. A. Rohwer, to whom the writer is very much indebted for encouragement and assistance in his studies of the sawflies.

Neodiprion (Zadiprion) vallicola Roh.

When Rohwer described *N.* (*Z.*) *vallicola* (Proc. Ent. Soc. Wash., Vol. 20, No. 4, Apr., 1918, p. 84), he had but a single female specimen, collected at Meadow Valley, Mexico, by C. H. T. Townsend. Since that time four specimens (two females and two males) have been received from Dr. A. M. Dampf, Head of Research, Plant Protection Service, San Jacinto, Mexico, which were reared from larvae collected at Erongaricuaro, Michoacan, Mexico, from *Pinus acacahuate.* Rohwer indentified these recent females as his species, and since the males were reared with them the following description of the male should serve to assist in the recognition of the

species and in increasing the information available on the subgenus.

Male.—Body length 7.5 to 8 mm.; head width 2.4 to 2.6 mm., height 1.9 to 2 mm. Head black except as otherwise noted; antennae of 25 or 26 joints, the apical four uniramose and swollen, joints 4 to 20 biramose, the exterior rami longer than the interior, joint 3 uniramose, the prong broadened basad of the middle; mandibles brown with base and apex black, long yellowish-brown hairs on the exterior part of the base; labrum yellowish, polished, and with a few long brown and a number of shorter yellow hairs, rather strongly convex, apical margin rounded without a median dent, almost symmetrical; clypeus entirely black, not strongly convex but without the transversely depressed polished and unpunctured apical clypeal area of the subgenus *Neodiprion*, coarsely and rather evenly punctured, strongly and narrowly emarginate, apically the emargination less wide than the width of the labrum, the lateral portions of the apical margin as long as the width of the emarginated median portion, distinctly separated from the supraclypeal area by an impressed line; supraclypeal area black and evenly punctured, punctures finer and denser than on clypeus, more strongly convex than clypeus, distinctly separated from the ventral interior margins of the antennal socket by a shallow groove; interior and ventral margins of the antennal sockets raised, area between antennal sockets and above interantennal line rugose and with a rather distinct pit; face distinctly, evenly, and coarsely punctured, lower portion with a number of long yellowish hairs; ocellar area slightly elevated, punctured to rugose, and slightly depressed below the median ocellus, the lateral slopes defining the area not abrupt and not distinctly divided by a transverse ridge extending toward upper third of compound eye; postocellar line a rather distinct groove, shorter than the ocellocular line; postocellar area not bulging, not glistening, and very densely and coarsely punctured, not distinctly defined laterally but about four times as wide as median length; vertex with a faint brownish area posterior to compound eye.

Thorax black except as otherwise noted; pronotum black, densely and coarsely punctured and with long, fine, whitish hairs; prescutum very densely and evenly punctured with punctures of one size which, while moderately coarse, are distinctly smaller than those on face; scutum even more densely punctured than prescutum, hairs not prominent on either scutum or prescutum; mesoscutellar plate coarsely, densely, and evenly punctured, all punctures of about the same size and somewhat but not greatly larger than those on scutum; first parapteron black and densely punctured; mesepisternum evenly and coarsely punctured, the punctures on the lateral areas somewhat more coarse and close together than those on the venter, with rather long whitish hairs; legs with coxae, trochanters, and basal three-fourths of femora black, apex of femora, tibiae and tarsi yellow; wings hyaline, almost clear, iridescent and with veins brownish, base of stigma black, center of stigma almost clear.

Abdomen black, except ninth tergite, pleural spots, sternal spots, and apex of hypandrium, which are yellowish; hypandrium coarsely and evenly punctured, other sternites with a few punctures and a surface somewhat like that of the tergites, either finely granular or finely rugosely striate; basal plates with a few coarse punctures immediately behind the metascutellar plate and the cenchri.

TWO NEW SPECIES OF SAWFLIES OF THE SUBGENUS NEODIPRION.

By WILLIAM MIDDLETON,

Entomologist, Branch of Forest Insect Investigagions, Bureau of Entomology, U. S. Department of Agriculture

The following descriptions are of two new species of sawflies[1] that are of economic importance as defoliators of pine. *Neodiprion* (*Neodiprion*) *swainei* n. sp. has been abundant in western Quebec, Canada, where it has been infesting jack pine (*Pinus banksiana*). *Neodiprion* (*Neodiprion*) *burkei* n. sp. has been attacking lodgepole pine (*Pinus contorta*) in the vicinity of West Yellowstone, Montana. Both species are described now in order to permit the use of the names of the insects in economic entomological literature within a short time.

Neodiprion (Neodiprion) swainei, n. sp.

This species is nearest to *Neodiprion* (*Neodiprion*) *dyari* Roh., but differs from it in the following respects.

The female of *dyari* has the posterior angle of the prescutum rounded, while it is sharp in *swainei;* posterior lateral margins of prescutum almost unpunctured in *dyari*, distinctly and rather coarsely punctured in *swainei;* anterior margins of scutellum forming a sharper angle (a right angle) in *dyari*, more obtuse than a right angle in *swainei;* antennae of 19 or 20 joints in *dyari*, of 16 or 17 joints in *swainei.*

Female.—Body length 7 mm.; head width 2 mm., height 1.7 mm. Antennae of 17 joints (both right and left), length of antennae about 1¾ mm. (slightly less long than the head is wide), joint 3 longer than joint 4, black, base of joints 1 and 3 and apex of joint 2 usually brownish; mandibles dark brown, tip black, base light brown, with long golden hairs on the exterior at the base; labrum yellowish brown, anterior margin rounded, the curve only slightly greater than that of outer margin of the mandible, with a dense apical fringe of long golden hairs; clypeus more polished than labrum, lighter brown than the face between the compound eyes, anterior margin broadly and shallowly emarginate, anterior one-half to one-third unpunctured and depressed transversely, basal portion raised transversely, punctured like the face and with hairs; supraclypeal area shining, less distinctly and coarsely punctured than the face, separated from the antennal sockets by grooves, somewhat convex; face shining, distinctly and coarsely punctured, and with golden hairs, slightly concave immediately above the interantennal line, darker brown below the postocellar line than above; postocellar area almost twice as wide as long, moderately convex, postocellar

[1]Both species belong to the subgenus Neodiprion, genus Neodiprion, sub~~family Diprioninae, family Tenthredinidae~~, superfamily Tenthredinoidea, suborder Chalastogastra, order Hymenoptera.

line distinctly impressed, longer than the ocellocular line, margins of the postocellar area and the antennal furrows very dark brown to blackish.

Thorax: Pronotum yellow to yellowish brown, punctured rather densely and evenly, the punctures almost as large as those on the face, shining, and with short golden hairs; proepisternum dark yellowish brown to almost black, shining but densely punctured; prescutum usually blackish and usually as dark as the lateral lobes of scutum, the posterior lateral margins less black; prescutum polished and shining, rather evenly punctured, the punctures toward the median line and anteriorly finer, those along the posterior lateral margins coarser, the posterior angle sharp, not rounded, the median line distinct but not heavy, faintly impressed except for the posterior sixth where it becomes a slight carina; tegulae yellowish, shining and punctured; scutum blackish, the posterior-lateral marginal ridge yellowish, polished and shining; scutum rather evenly punctured, those anteriorly and laterad less coarse, the posterior-lateral marginal ridge unpunctured; mesoscutellar plate distinctly wider than long, posterior margin rounded, anterior margin an obtuse angle with the anterior three-fifths of this margin on each side deeply impressed and the posterior two-fifths (where plate joins posterior-lateral marginal ridges of scutum) distinct but not deeply impressed; mesoscutellar plate yellow, shining, with a moderate number of very coarse punctures; lateral portions of the scutellum black, shining and smooth; first parapteron dark yellowish brown, densely punctured and with golden hairs; mesepisternum yellowish brown, often darker to blackish ventrally and shining, evenly, densely, and very coarsely punctured laterally and with golden hairs, highly polished and with fewer, finer punctures on the anterior and venter; metanotum black, the metascutellar plate somewhat less black at the lateral angles and the plate with a few coarse punctures; legs pale brown, frequently the bases of the tibiae and the trochanters paler, almost whitish; wings hyaline, vitreous (with a marked reddish iridescence), venation blackish, most of costa and center of stigma pale.

Abdomen: Basal plates very dark brown, rest of dorsum of abdomen black, the pleural regions of the tergites to the eighth pale with a greenish tinge ventrad from above the spiracle, the ninth dark yellowish brown; sternites of abdomen pale, whitish to yellowish brown, with a greenish tinge apparently due to the color of the contents of the abdomen; sheath with basal portion yellowish brown, apical portion darker brown to almost blackish, pads thin but presenting a ventral surface about thrice as long as wide and separated from each other by about half their length.

VARIATIONS OF SIX OF THE FEMALE PARATYPES (MEASUREMENTS IN MILLIMETERS).

Body length	6.3	6.8	6.3	6.8	6.5	6.2
Antennae, right, left	1.5–1.5	1.5–x	2–1.9	1.9–x	1.9–x	x–1.8
Head width	1.8	1.8	1.9	1.9	1.9	1.8
Head dorsad-ventrad height	1.6	1.7	1.7	1.7	1.6	1.6
Antennal joints, right, left	17, 17	16–x	17, 16	17–x	17–x	x–17

x = Complete antennae wanting.

Agree with type (except one specimen with a malformed clypeus,) with the following variations: Proepisternum dark yellowish brown to very dark brown; plate of metascutellum often entirely black; basal plates sometimes practically no lighter than rest of dorsum of abdomen; pads on the sheath sometimes separated by more than one-half their length but hardly by their full length.

Male.—Body length 5.5–6 mm.; head width 1.9 mm., height 1.4 mm. Head black except where otherwise noted; antennae of 19 or 20 joints, the apical three joints appearing fused, the ultimate bead-like, the next two uniramose, the remainder to joint 3 at the base biramose, joint 3 uniramose with the prong crooked, joints 1 and 2 without rami; mandibles dark brown, the base blackish and with curved pale hairs on the exterior of the basal portion; labrum yellow, polished, with an apical fringe of long hairs projecting ventrally, apical margin distinctly rounded; clypeus reddish brown apically and at middle, black at the lateral basal margins, apical margin broadly and shallowly emarginate, apical third highly polished and transversely depressed, basal two-thirds prominent and with coarse punctures, more coarsely punctured and rougher than the supraclypeal area, distinctly separated from the supraclypeal area by a straight impressed line; supraclypeal area convex and finely punctured; face densely and coarsely punctured; ocellar area raised and very rough, punctures coarse and usually more dense than on the face, median ocellus in a longitudinal depression; width of postocellar area three or four times its median length, faintly divided, often not distinctly defined laterally and more sparsely or indistinctly punctured than the lower face; postocellar line distinctly impressed and longer than the ocellocular line.

Thorax: Black; pronotum densely punctured, the punctures finer than those on the face and slightly coarser than those in the median and anterior area of the prescutum; prescutum evenly and finely punctured on the median and anterior surface, coarsely and irregularly punctured along the posterior lateral margins; tegulae almost entirely yellow and punctured; scutum somewhat coarsely punctured on the median surface, more finely punctured on the anterior and lateral portions; mesoscutellar plate large, distinctly wider than long, anterior angle obtuse, deeply, coarsely, distinctly, and rather evenly punctured, punctures deeper and coarser than those on the face; mesepisternum coarsely and evenly punctured laterally and finely or almost unpunctured on the venter; metanotum black, the metascutellar plate and the area immediately behind the cenchri coarsely punctured; legs reddish brown, coxae with black; wings hyaline, veins for the greater part colorless.

Abdomen: Tergites black, polished, and almost entirely unpunctured; sternites, including the hypandrium, reddish with shallow punctures and short hairs, apical margin of hypandrium sometimes with a shallow median emargination.

Type locality.—Mont Laurier District, Quebec.

Described from nine females (one type) and seven males (one allotype) from the type locality The material was collected and reared by M. Dunn. The larvae fed upon *Pinus banksiana.*

Type, allotype, and *paratypes*.—Cat. No. 43468 U. S. N. M. Three female and two male paratypes deposited with the Canadian Entomological Branch, the remainder in the U. S. National Museum collection in Washington, D. C. This species is named in honor of Dr. J. M. Swaine, Associate Dominion Entomologist, of the Entomological Branch of the Department of Agriculture of Canada, who has directed the studies in forest entomology of the Dominion through which this species was discovered.

Neodiprion (Neodiprion) burkei, n. sp.

This species is nearest to *Neodiprion* (*Neodiprion*) *scutellatus* Roh., but differs from it chiefly in the female having the abdomen dark and the abdomen and the mesoscutellum darker than the head. It also differs in the female possessing antennae with 18 or 19 joints and in the female having the ventral, interior margins of the basal portion of the sheath strongly rolled so that the margins about touch midway between the basal articulation of the sheath and the point of origin of the rods of the posterior portion of the sheath. The ventral-interior margins of the basal portion of the sheath thus present a long, wide-curving, basal V and also curve away from each other after they about touch each other midway of their length. The male of *N.* (*N.*) *scutellatus* Roh. is not known.

Female.—Body length 7.5 mm. (paratypes with body length ranging from 6.5 mm. to 8 mm.); head width 2 mm., height 1.6 mm. Color yellow except as otherwise noted; antennae of 18 joints (both right and left), (in the paratypes the joints of the antennae range from 16–19), length slightly more than 2 mm., blackish, base of first joint and dorsum of joint 3 somewhat yellowish or brownish; mandibles brownish, basal portion yellowish and with yellow hairs on the exterior; labrum yellow, shining, and with a dense apical fringe of yellow hairs, apical margin from rounded to a bluntly rounded angle; clypeus yellow, apical margin shallowly emarginate for about the width of the labrum, apical third distinctly transversely depressed, polished and unpunctured, basal two-thirds somewhat convex, shining but moderately punctured and with yellow hairs, clypeus distinctly separated by a brown suture from the supraclypeal area; supraclypeal area yellow and strongly convex, not punctured, separated from the antennal sockets by grooves diverging ventrally; face yellow, less distinctly punctured opposite compound eyes than above the eyes, with long yellow hairs below antennae, dark brown in the short groove or furrow immediately above each antenna, this groove or furrow not connected with the groove laterad of the lateral ocelli; groove of the median ocellus, the postocellar groove, and the grooves and the portions of the ocellar area immediately adjacent to the lateral ocelli dark brown; ocellar area frequently punctured, raised but not distinctly separated from the face midway between the lateral ocelli and the antennal sockets, the median ocellus usually situated in a slight depression formed by a distinct inverted U or V shaped groove, a shallow median pit just above and

between the antennal sockets; postocellar area well defined laterally and anteriorly with darkened sutures, prominent, not deeply or coarsely punctured but with rather even, shallow, coarse punctures, punctures less distinct and frequent than those on the adjacent facial areas; postocellar line distinct and impressed.

Thorax: Pronotum yellow white, paler than the head, with shallow, coarse punctures and whitish hairs; prescutum dark brown, sometimes less dark along the lateral margins and in the posterior angle, with sparse yellow hairs and faintly evenly punctured, the punctures less distinct along the lateral margins and in the posterior angle; tegulae white and unpunctured; scutum paler brown than the prescutum, punctures indistinct, especially on the median and posterior areas; mesoscutellar plate about as long as wide, anterior angle somewhat acute or a right angle (not obtuse), posterior margin rounded and somewhat produced medianly, plate unpunctured and with some hairs; first parapteron pale yellowish white and with possibly a few indistinct punctures and hairs; mesepisternum yellowish, with fine punctures and yellowish hairs; metanotum (including the metascutellar plate) black, plate unpunctured; legs entirely yellowish; wings hyaline, veins blackish, the costa and stigma pale brown.

Abdomen: Tergites black, basal plates black, pleurum pale yellowish with a few faint punctures, pleurum of the ninth tergite yellowish to slightly brownish; sternites yellowish, the last before the sheath somewhat brownish; sheath with the basal portion yellowish, the apical portion brownish, the ventral-interior margins of the basal portions strongly rolled inwards and almost touching about midway of their length, forming a long curving V between the halves of the sheath basad of the point where they almost touch, the apical portion of the sheath brown with the rods equal to or slightly longer than the pads, the length of the pads three times their width, the pads hardly separated from each other by their width.

Male.—Body length 6 mm.; head width 1.9 mm., height 1.4 mm. Black except as otherwise noted; antennae of 21 joints, the apical joint a bead, the next to the apical joint uniramose, the third joint from the base uniramose with the prong somewhat crooked, joints 4 to 19 biramose, the rami on the exterior longer; mandibles brown, black at the base and with yellowish hairs at the base on the exterior; labrum brown, somewhat shiny but with many yellow hairs forming an apical fringe, apical margin rounded or curved (curve parallel with curve of mandible); clypeus black, apical margin shallowly emarginate, apical half unpunctured, transversely depressed and polished, basal half punctured, convex but not strongly so, separated at base from the supraclypeal area by a straight line not deeply impressed; supraclypeal area black, convex but not strongly so, and not distinctly punctured, separated from the antennal sockets by broad shallow depressions; face rough and punctured below a line through the antennae and rather smooth and punctured above, hairs yellowish and rather sparse; ocellar area raised, rugose rather than punctured, lateral margins rather well defined and the postocellar line a deeply impressed groove, the pit of the middle ocellus with distinct lateral grooves; postocellar area well defined, prominent or bulging, width about three times median length, punctures finer than those on adjacent areas of face, and with a distinct depression of the postocellar line occurring laterad of each of the anterior lateral angles of the postocellar area.

Thorax: Black except as otherwise noted; pronotum with long pale hairs, roughened by shallow almost confluent punctures; prescutum finely and rather evenly punctured, punctures in the posterior angle very faint; tegulae brownish to black, without punctures; scutum finely and rather evenly punctured, the punctures anteriorly and at sides most distinct; mesoscutellar plate practically unpunctured except for a few fine punctures posteriorly, anterior angle about a right angle and the length of the plate about equal to the width, the posterior margin rounded and somewhat produced medianly; metanotum black and with the metascutellar plate unpunctured; legs with coxae blackish, trochanters mostly dark, remainder of legs yellow; wings hyaline, almost clear, somewhat iridescent, veins brown.

Abdomen: Tergites black to the ninth which varies from black to brownish, basal plates somewhat punctured; genitalia yellowish brown; sternites and pleurum of the tergites dark brownish to blackish and punctured, hypandrium blackish and evenly punctured.

Type locality.—West Yellowstone, Montana.

Described from 20 females (one type) and 27 males (one allotype) from the type locality. The material was collected June 6, 1925, and the larvae fed upon *Pinus contorta*.

Type, *allotype*, and *paratypes*.—Cat. No. 43469 U. S. N. M. All are deposited in the National Museum collection at Washington, D. C.

This species is named in honor of Dr. H. E. Burke, who collected the specimens.

NEW AND LITTLE-KNOWN DIAPRIIDAE FROM BRITISH COLUMBIA. (HYMENOPTERA).

By Oscar Whittaker.

The following descriptions and notes are made from material collected in western British Columbia by the writer. Except where otherwise stated all this material remains in the writer's collection.

BELYTA Jurine.

Of this genus I have taken five species, four of which are described below as new, and as far as can be ascertained no other species of the genus have been recorded from this province before.

Belyta longicollis, Fouts.

I have taken both sexes of this species at Hollyburn on various dates between 7 July and 24 October, 1928–30. I am indebted to my friend Mr. Robert M. Fouts for kindly comparing several of my specimens with the type. The type

material consists of a single female from Pennsylvania. The male is now described for the first time.

Male.—Coloration as in the female, the flagellum somewhat darker. Head globular, ocelli in an equilateral triangle, lateral ocelli nearer together than to the eyes; the occiput with a carina surrounding the neck. Antennae a little longer than head, thorax and petiole combined; scape about four and one-half times as long as thick, as long as joints 3 and 4 combined; pedicel subglobular, a little longer than thick; joint 3 nearly three times as long as pedicel, two and one-half times as long as thick, moderately excised on basal half, the side opposite the excision curved; joint 4 two-thirds as long as joint 3, about twice as long as thick; joints 4–13 gradually shorter; joint 13 about three-quarters as long as joint 4; apical joint conic-ovate; nearly one and one-half times as long as preceding joint. Thorax twice as long as wide. Pronotum, seen from above, wider than usual in this genus, gradually narrowed anteriorly (not bulging out in front of tegulae, as in the female), the sides almost straight, anteriorly rugoso-punctate, with a deep median depression, the sides smooth, the neck longitudinally sulcate. Forewings two and one-quarter times as long as their greatest width. Abdomen, including petiole, longer than head and thorax combined; exclusive of petiole, a little more than twice as long as wide.

An examination of twelve males and six females shows this to be a somewhat variable species. The dorsum of the propodeum in both sexes may be almost smooth with only a very slight irregularity of surface or, more often, with distinct, irregular, transverse, raised lines. The median carina of the propodeum in one female is bifurcate for only one-quarter its length, while in two males it is bifurcate for nearly its entire length. The petiole in one female is only one and three-quarter times as long as wide. The length varies in the male from 2.7 to 3.5 mm. and in the female from 3.5 to 4.0 mm.

Belyta sanguinea, new species.

Female (Type).—Head, thorax and petiole black; scape black, the radicula and apex yelowish, pedicel and flagellum yellowish-red, apical joint dark brown; legs, including coxae, reddish-yellow, base of hind coxae blackish; basal two-thirds of second tergite reddish, rest of abdomen brown; wings faintly fumose; tegulae and venation brown. Head smooth and shining, rounded behind the eyes, as wide as long; eyes remote from occiput; ocelli in an equilateral triangle, lateral ocelli slightly nearer together than to eyes, twice as far from the occiput as from one another. Antennae with long, pale pubescence, flagellum proximally submoniliform, becoming moniliform distally, almost as long as head, thorax and petiole combined; scape four times as long as thick, as long as following four joints combined; pedicel short, less than one-quarter as long as scape, slightly longer than joint 4; joint 3 about one and one-half times as long as pedicel and about one and one-half times as long as thick, thickest at the apex; joint 4 about as thick as long; following joints about as long as joint 4, becoming gradually thicker; joint 14 very slightly thicker than long; apical joint as long as joint 3, one and one-half times as long as thick; flagellum three times as long as scape. Thorax about twice as long as wide. Pronotum short, produced in a short, irregularly, sulcate neck. Mesonotum wider than long, flat, with distinct, per-

current notauli. Scutellum flat, basal fovea transverse, shallow. Propodeum with the dorsum smooth but somewhat uneven, hind margin straight, carinate, the median carina bifurcate for more than half its length. Forewings narrow, about three times as long as their greatest width; first abscissa of radius oblique, much shorter than marginal vein; radial cell one and one-half times as long as marginal vein; cubitus, discoideus and brachius present as faint, fuscous streaks; cubitus short, straight, directed towards the basal nervure. Petiole a little less than one and one-half times as long as wide, widest at the hind margin; front margin feebly sinuous, the sides almost straight, hind margin straight, longitudinally striate, feebly rugulose between the striations. Abdomen highly polished, somewhat depressed, elongate oval; including petiole, as long as head and thorax combined; exclusive of petiole, twice as long as wide; second tergite with a few, very short striae at the base, slightly less than one and one-half times as long as wide, about two and one-quarter times as long as rest of abdomen; following tergites very short, the last longer. Dorsum of mesonotum and scutellum and sides of these, propodeum and petiole with long, scattered, pale hairs.

Male (*Allotype*).—Similar to female but differing as follows. Antennae blackish-brown, except apical half of scape, base of pedicel and basal half of joint 3, which are reddish; legs slightly darker than in the female, the tarsi, except basally, inclining to brown; venation also darker than in female. Head a little more than one and one-half times as wide as long. Antennae slender, filiform, pubescent, longer than head, thorax and petiole combined; scape slightly more than four times as long as thick, a little longer than joint 3; pedicel globular; joint 3 excised on basal half, three times as long as its greatest width; joint 4 about two and one-half times as long as thick, as long as joint 3; following joints gradually shorter; joint 13 twice as long as thick and two-thirds as long as joint 4; apical joint as long as joint 4. Petiole two and one-half times as long as wide, sides almost straight, hind margin slightly wider than front margin, with two fine, longitudinal striae on dorsum and two lateral striae visible from above. Forewings with the radial cell twice as long as the marginal nervure; first abscissa of radius oblique, shorter than marginal nervure. Abdomen, including petiole, about as long as head and thorax combined; exclusive of petiole, twice as long as wide; second tergite one and one-half times as long as wide, four times as long as rest of abdomen.

Length, 3.0–3.6 mm; *expanse*, 4.2–6.5 mm.

Described from one male, 3rd September, 1929, and six females, 24th August to 19th October, 1930, taken at Hollyburn.

Variation.—The color varies slightly in depth and one specimen has the penultimate as well as the apical flagellar joint dark brown. Two females have the petiole dorsally smooth and in one female the median carina of the propodeum is almost obsolete, its position beyond the basal portion being indicated by an elongate, triangular, smooth, raised area; the posterior marginal carina is almost obsolete.

Paratypes sent to the U. S. N. M., Dr. A. A. Ogloblin and Mr. Robert M. Fouts.

Belyta boreale, new species.

Female.—Black, shining; scape and pedicel brown, flagellum darker brown, legs brownish-yellow, hind coxae, except apically, dark brown; wings faintly fumose; tegulae and venation brown. Head nearly one and one-half times as wide as long, rounded behind the eyes; ocelli in a triangle with a depression before front ocellus and external to the lateral ocelli; lateral ocelli about as far apart as from the eyes. Antennae pubescent, moniliform beyond joint 4, as long as head, thorax and petiole combined; scape robust, about four times as long as thick, one-third as long as rest of antenna, as long as following four joints combined; pedicel one and one-half times as long as thick; joint 3 two and one-half times as long as thick, one and one-half times as long as pedicel, as long as joints 4 and 5 combined; joint 4 very slightly longer than joint 5; joints 5–14 subequal, joint 14 very slightly thicker than long, one-half as long as joint 3; apical joint conic-ovate, one and one-half times as long as thick. Thorax about one and three-quarter times as long as wide. Pronotum short, produced in a stout, sulcate neck. Mesonotum somewhat convex, with distinct percurrent notauli; scutellum with a shallow, transverse, basal fovea. Propodeum smooth and shining; the hind margin nearly straight; median carina bifurcate for one-quarter its entire length. Head and thorax with long, fairly dense, pale hairs. Forewings broad, about twice as long as their greatest width; first abscissa of radius somewhat oblique, nearly as long as marginal nervure; radial cell three times as long as marginal nervure; cubitus, discoideus and brachius present as faint fuscous streaks, the cubitus straight, directed towards the basal nervure. Petiole one and one-half times as long as wide, front and hind margins straight, the sides feebly sinuous, hind margin a little longer than front margin, dorsum and sides longitudinally rugoso-striate. Abdomen highly polished, convex; including petiole, about as long as head and thorax combined, exclusive of petiole, oval, about one and three-quarters times as long as wide; second tergite about one and one-third times as long as wide, three times as long as rest of abdomen, longitudinally striate at base, the median sulcus not conspicuously longer than the others, shorter than hind margin of petiole; segments 3–6 gradually shorter; 6 one-half as long as 3; 7 slightly longer than 3. Petiole and abdomen with long, pale hairs, longest on sides of petiole, scattered on dorsum of second tergite, closer on sides and on following segments, except in the centre.

Length, 2.5–2.8 mm; *expanse,* 4.8 mm.

Described from three females taken at Hollyburn, 25 August, 1928, 30 September, 1929, and 10 October, 1930.

Paratype sent to Mr. Robert M. Fouts.

In one paratype the antennae are paler than in the type.

Belyta anthracina, new species.

Female.—Black, shining; antennae dark brown; scape, except apex, black; legs yellowish-brown, base of hind coxae dark brown; wings faintly fumose, tegulae and venation brown. Head smooth and polished, as long as wide, rounded behind eyes, occiput surrounded by a carina; ocelli in an equilateral triangle, lateral ocelli nearer together than to the eyes, twice as far from occiput as from each other. Antennae robust, pubescent, moniliform, nearly as long as

head, thorax and petiole combined; scape one-third as long as rest of antenna, about four times as long as thick, as long as following four joints combined; pedicel one and one-third times as long as thick; joint 4 slightly longer than pedicel, one and one-half times as long as thick, as long as following two joints combined; joints 5–14 subequal, joint 5 as long as thick, joint 14 very slightly thicker than long, only very slightly longer and thicker than joint 5; apical joint ovate, one and one-half times as long as thick, one and one-half times as long as preceding joint. Pronotum laterally very narrow, with a few shallow punctures in front, the median one larger and deeper, produced in a broad, logitudinally sulcate neck. Mesonotum and scutellum flat; mesonotum with deep, percurrent notauli; scutellum with a shallow, transverse, basal fovea. Propodeum with the median carina fine, bifurcate for more than one-half its length; the dorsum smooth, rugulose between the branches of the median carina and along the lateral carinae and hind margin; hind margin almost straight, carinate, the hind angles not produced. Forewings about two and one-half times as long as their greatest width; first abscissa of radius oblique, shorter than the marginal nervure, radial cell nearly twice as long as marginal nervure; cubitus, discoideus and brachius present as faint, fuscous streaks, the cubitus almost obsolete, directed towards the basal nervure. Petiole cylindrical, twice as long as wide, front margin slightly emarginate, hind margin and sides straight, the dorsum feebly rugulose, with inconspicuous, longitudinal striations which are obsolete in the middle. Abdomen highly polished, convex; including petiole, as long as head and thorax combined; exclusive of petiole, a little more than twice as long as wide; second tergite one and two-fifths as long as wide, about three times as long as rest of abdomen, with short striae at the base, the median sulcus much longer than the others, extending for two-fifths the length of the tergite, about as long as petiole; tergites 3 to 5 about equal, the sixth about as long as 4 and 5 combined; the seventh about equal to the sixth; the entire body with scattered, long, pale hairs.

Length, 3.1 mm.; *expanse*, 4–8 mm.

Described from a single specimen taken at Hollyburn, 15 June, 1930.

Belyta excavata, new species.

Female.—Black, shining, antennae brownish-yellow, becoming darker on the apical half; legs brownish-yellow, base of hind coxae dark brown; wings faintly fumose, tegulae and venation brown. Head as wide as long, rounded behind eyes, occiput surrounded by a fine carina; ocelli in a triangle, lateral ocelli nearer together than to eyes or occiput. Antennae as long as head and thorax combined; flagellum proximally filiform, distally moniliform; scape robust, a little less than four times as long as thick, as long as following five joints combined; pedicel about one-quarter as long as scape, slightly longer than thick; joint 3 a little longer than pedicel; joint 4 slightly more than one-half as long as joint 3; following joints very gradually longer; joint 14 one and one-half times as long as joint 4, slightly thicker than long; apical joint conic-ovate, one and one-half times as long as preceding joint and one and one-half times as long as thick. Thorax twice as long as wide, somewhat flattened. Pronotum short,

produced in a short, stout neck. Mesonotum with distinct, percurrent notauli; basal forea of scutellum shallow. Propodeum with the hind margin deeply emarginate, straight in the centre, the hind angles considerably produced; median carina bifurcate for nearly its entire leng·h, dorsal areas smooth, laterally and posteriorly with irregular, punctate depressions. Forewings narrow, nearly three times as long as their greatest width; first abscissa of radius very oblique, about one-half as long as marginal nervure, second abscissa of radius short, continued as a very faint, hardly visible, fuscous streak to the costal margin, the enclosed area about as long as marginal nervure; cubitus, discoideus and brachius present as very faint, fuscous streaks, the cubitus directed towards the discoideus. Petiole one and one-half times as long as wide; front and hind margins straight, the latter considerably longer than the former, sides convex; irregularly, longitudinally striate, the surface between the striae somewhat uneven. Abdomen, including petiole, as long as head and thorax combined; exclusive of petiole elongate-oval, twice as long as wide; second tergite one and one-half times as long as wide, four times as long as rest of abdomen, base shortly striate, the median sulcus extending for about one-sixth the length of the tergite; segments 3–5 about equal, sixth segment longer. Entire body with scattered, pale hairs, sparsest on dorsum of second tergite.

Length, 3.5 mm.; *expanse*, 4.5 mm.

Described from five females taken at Hollyburn on various dates between 6 June and 2 October, 1929–30.

Paratype sent to Mr. R. M. Fouts.

Variation.—The antennae may have the basal half of the scape dark brown and the flagellum darker than in the type, the apical joints being very dark. The length varies from 2.75–3.5 mm. and the expanse from 4.0–5.5 mm.

PROPSILOMMA Foerster.

Propsilomma columbianum, Ashmead.

(=**Psilomma columbianum,** Ashm.)

I have taken a couple of males of this species, one at Hollyburn, 18 July, 1929, and one at Galiano, 24 June, 1930.

DIPHORA Foerster.

Diphora nearctica, Whitt.

(*Proc. Ent. Soc. Wash., Vol. 32, p. 74.*)

The type material is stated to contain both sexes. This is an unfortunate error, as they are all females. I was misled through mistaking the peculiar ovipositor (which is short and bent into a hook at the apex) for the uncus. In working through my collection I have found twelve specimens which are undoubtly males of this species. It is possible that this genus is synonymous with *Pantoclis* Foerster.

Male.—In color and general appearance similar to the female. Antennae slender, filiform, longer than the entire body; scape four times as long as thick; pedicel globular; joint 3 as long as scape, four times as long as thick, excised, but not deeply, on basal one-fourth; joint 4 shorter than joint 3; joints 3–13 gradually shorter; joint 13 two-thirds as long as joint 4; apical joint about one and one-fourth times as long as preceding joint. Petiole one and one-third times as long as wide. Abdomen, including petiole, about as long as head and thorax combined; exclusive of petiole, twice as long as wide; second tergite one and one-half times as long as wide; fourth and fifth tergites each about one-half as long as the preceding tergite.

Length, 2.2–2.8 mm.

Taken at Hollyburn, 11 June–20 September, 1928–30.

SEASONAL HISTORY AND MORPHOLOGICAL NOTES ON POLYSCELIS MODESTUS GAHAN.

By C. C. Hill and H. D. Smith,
U. S. Bureau of Entomology, Cereal and Forage Insect Investigations.

INTRODUCTION.

The general life history of this species was published by P. R. Myers[1] in 1924. At that time, it was thought to be a rare parasite of the Hessian fly, but in 1928 it was found by the authors to be parasitizing, in considerable numbers, the fall generation of the Hessian fly during the very early spring days. It is the purpose of this paper to call attention to this latter occurrence and also to present some additional morphological details which were lacking in the earlier account by Myers.

EXTENT OF PARASITISM.

In the spring of 1928 adults of *Polyscelis modestus* were found in two wheat fields that were heavily infested with the Hessian fly. One was located near Carlisle, Pa., and the other about 8 miles south of Carlisle near Mt. Holly Springs, Pa. On May 7, by which time the period of oviposition of *P. modestus* was past, a sample of 100 Hessian fly puparia was secured from the field at Mt. Holly Springs, and dissection showed 33 per cent of them to be parasitized by *P. modestus*.

OVIPOSITION.

Hessian fly puparia containing both larval and pupal stages were found to be parasitized indiscriminately. As the season advanced, pupae in all stages of development were found which

[1]Jour. Agr. Research, Vol. XXIX, No. 6, p. 289–295, 1924.

had been oviposited upon by this parasite. The parasitic egg was always found loosely placed on the surface of the Hessian fly larva or pupa within the puparium. The egg (fig. 1), which is normally ovate, was sometimes found bent near its smaller end as though it had been lodged in a restricted position between the host and the wall of its puparium. The appearance of the egg shell after hatching is shown in Figure 2.

The female apparently stings her host before ovipositing. Hosts taken in the field bearing eggs of *P. modestus* were always found in a paralyzed condition, and there were always present one or more black spots in the epidermis where the ovipositor of the parasite had punctured the tissue. Captive females were observed to insert their ovipositors through the wall of a puparium of the host several times before finally ovipositing. It usually took about 24 hours for the point through which the ovipositor was thrust to appear as a black spot. The dark area was found to penetrate a slight distance into the host's body. In only one instance was the female observed to place her mouth to the point pierced by the ovipositor as though to feed on host material.

MORPHOLOGY.

In the publication by Myers previously mentioned, descriptions were given of the egg, primary larva, mature larva, prepupa, pupa, and adult, together with figures of the egg, mature larva, front view of head, and mandibles of the same stage, and the pupa. Since further studies on this parasite have afforded the opportunity to make additional morphological observations, there are included in the present paper descriptions of the stages which were previously lacking, together with more detailed morphological descriptions of some of the other stages than were given by Myers. The figures of the egg and pupal stages are reproduced from Myers for the sake of continuity and in order to illustrate more clearly the morphological changes undergone during the growing period.

The larva was found to pass through five instars. These may be distinguished by the size and appearance of the mandibles (figs. 3–7). Measurements of the mandibles from apex to exterior margin of the condyle showed the following differences: instar I, 0.015 mm.; instar II, 0.027 mm.; instar III, 0.033 mm.; instar IV, 0.047 mm.; instar V, 0.053 mm. The first-instar larva (fig. 8), besides being smaller, differs conspicuously from the other instars by the large size of its head and thorax as compared with the rest of the body, and by the sharpness with which the abdomen tapers to the caudal extremity. It has well defined antennae and its mouth parts (fig. 9) are capable of considerable protrusion. Spiracles are present on the mesothorax and first three abdominal segments.

The second, third, and fourth instars appear essentially the same as the last instar except in size and minor details. In these instars spiracles are found on the mesothorax, metathorax, and first seven abdominal segments. The lateral seta located near each side of the mouth is conspicuous in the second instar but in subsequent instars decreases in length relative to the increase in size of the body. The ventral view of the head of the full grown larva is depicted in Figure 10, showing the position of the mouth parts, setal arrangement, and antennae. The shaded area shows the position of the mandibles, duct of the silk gland, and supporting chitinous structure, all of which are hidden more or less beneath the surface. The antenna of the full-grown larva is 0.01998 mm. long and is shown in Figure 11. The lateral aspect of the larva is shown in figure 12 and the setal arrangement on its caudal extremity in Figure 13. Ventral aspects of the prepupal and pupal stages are shown in figures 14 and 15.

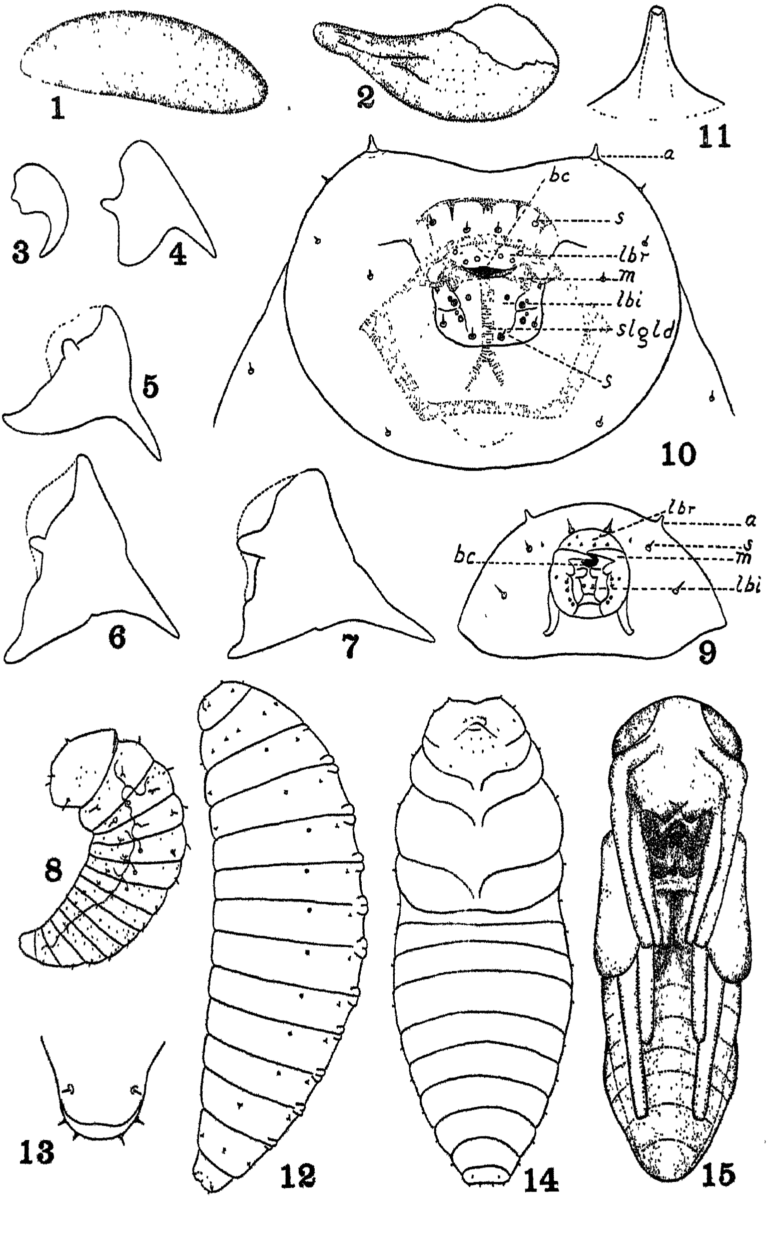
EXPLANATION OF PLATE.

Figures drawn by C. C. Hill.

1. Egg (length 0.38 mm.) (After Myers.)
2. Eggshell after hatching (length 0.35 mm.).
3. Mandible of first-instar larva (distance from apex to outer margin of condyle 0.015 mm.).
4. Mandible of second-instar larva (distance from apex to condyle 0.027 mm.).
5. Mandible of third-instar larva (distance from apex to condyle 0.033 mm.).
6. Mandible of fourth-instar larva (distance from apex to condyle 0.047 mm.).
7. Mandible of full-grown larva (distance from apex to condyle 0.053 mm.).
8. First-instar larva, lateral aspect (length 0.2736 mm.).
9. Ventral aspect of head of first-instar larva showing position of mouth parts, setae, and antennae (head width 0.1225 mm.).
10. Ventral aspect of head of full-grown larva showing position of mouth parts, setae, and antennae. The shaded area is chitinized tissue beneath the surface and reveals the mandibles, silk-gland duct, and supporting chitinous structure (head width 0.60 mm.).
11. Antenna of full-grown larva (length of inside area shown by dotted line 0.01998 mm.).
12. Full-grown larva, lateral aspect (length 1.65 mm.).
13. Caudal extremity of full grown larva, ventral aspect, showing position of setae (greatly enlarged).
14. Prepupal stage, ventral aspect (length 1.8 mm.).
15. Pupal stage, ventral aspect (length 1.8 mm.) (After Myers.)

Abbreviations.

a, antenna	*m*, mandible
bc. buccal cavity	*slgld*, common duct of silk gland
lbi, labium	*s*, sensorial spine
lbr, labrum	


1
2
11
3
4
a
bc
s
lbr
m
lbi
slgld
s
5
10
6
7
lbr
a
s
bc
m
lbi
9
8
13
12
14
15

PAPER WASPS (POLISTES) IN BIRD HOUSES.

By W. L. McAtee.

In these Proceedings (Vol. 31, No. 7, Oct. 1929, p. 136) the writer reported experience for the year 1928 with *Polistes* in connection with a cooperative bird-attraction project at Bell, Maryland. It was then stated that tearing down the nests was the most practicable way of discouraging the wasps. When nests were torn down, the wasps present were killed so far as possible, but in most cases part of them escaped.

The amount of such discouragement necessary can now be shown as a result of four years' operations; see following table:

Year	*Number of times nests removed*							*Total number of bird houses having Polistes nests in them*
	1	*2*	*3*	*4*	*5*	*6*	*7*	
1928	20	12	4	2	....	.	....	38
1929	24	2	1	...	.	..	...	27
1930	28	13	3	1	..	..	....	45
1931	20	8	6	1	....	...	1	36
Totals	92	35	14	4	..	...	1	....

The total number of bird houses available was 98, of which in various years from 27 (27.5 per cent) to 45 (45.9 per cent were occupied by *Polistes*.

The persistency of the wasps in rebuilding is remarkable, in one case enduring through seven removals, but in general it is not so great as to condemn the method adopted as the most useful one of controlling the insects. Thus in 92 cases out of a total of 227, a single removal sufficed to free the nest box from the wasps for the season. In other words, one clearing out reduced the infestation 40.5 per cent. Two removals did away with an additional 31.5 per cent of the wasp colonies, while three contributed 18.5 per cent more.

The few bird houses usually concerned in individual efforts to attract birds can easily be freed of *Polistes* by manual methods applied preferably during the coolest periods available, as the insects are very sluggish then. Thorough cleaning out not only of interlopers such as the wasps, but of old nesting material after every brood, is essential to continued success in bird attraction.

THE BUTTERFLY BOOK (new and thoroughly revised edition), W. J. HOLLAND. *Doubleday Doran & Co., Inc., $10.00.*

Students of the Rhopalocera, as well as nature lovers the world over, will welcome with enthusiasm the appearance of this completely revised, much enlarged and, in many ways, more beautiful edition of Doctor Holland's invaluable work.

The original edition which appeared in December, 1898, has met a demand in excess of 65,000 copies and in its day satisfied a need not supplied by any other single publication. It contained 382 printed pages and 47 plates in color reproduced by the half-tone process.

In this new edition, the size of the printed page has been increased by about an inch each way, thus permitting the inclusion of nearly twice as much textual matter as appeared in the original, within the space of but 424 pages. In addition to these advantages, there are 77 ful-page plates, all but four of which are in color. The 29 new plates are quite the equal of, if not superior in quality, to those originally printed and the entire format is exceptionally fine.

The reader will recognize as a distinct improvement the rearrangement which places all of the plates, save the frontispiece, in numerical sequence at the end of the volume, a plan that serves the convenience of the reader for reference purposes.

In discussing this new edition with me, Doctor Holland has said, "I have endeavored to figure on the plates every species that is known on the continent from the Arctic Circle to the tip of Florida and the borders of Mexico, and I have used in the making of plates in a large majority of cases, types or paratypes, many of them lent to me by the U. S. National Museum, the American Museum in New York, my friends in Ottawa, and other possessors of types and paratypes of named species. I have endeavored to omit nothing from this new edition which is of interest to lepidopterists." After examining the volume, one is convinced that the author has attained his objective.

Those who are familiar with the older edition of this work will be more than pleased to discover that in the course of extensive revision, no part of that philosophic humor and poetic feeling which set Doctor Holland's original work quite apart from the ordinary book on entomology, has been sacrificed.

Dedicated as it was on the genial Doctor's eighty-second birthday and presented as a "farewell offering to the rising generation of entomologists in America," it is safe to predict that this book will be received with the grateful appreciation that it highly deserves and the general wish that its author may experience many happy returns of the day.—W. R. WALTON.

MINUTES OF THE 429th REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON.

The 429th meeting of the Entomological Society of Washington was held Thursday, May 7, at 8 P. M., in Room 43 of the new building of the National Museum. Dr. A. C. Baker, President, presided. There were present 46 members and 31 visitors. The minutes of the previous meeting were read and approved. There was no preliminary business.

The first communication on the regular program was presented by Prof. Wm. E. Hoffmann, Head of Department of Biology, Lingnan University, Canton, China, and was entitled "Remarks on Entomological Work in China Including an Account of an Expedition to the Interior of Hainan Island." He gave an historical account of entomological exploration in China during the last one and a quarter century and called attention to the major entomological works resulting therefrom. He reviewed the present status of entomological science in the country, including a statement as to the outlook for future work. Individuals engaged in entomological work as well as institutions and publications featuring entomology also were discussed in detail. Lantern slides of Lingnan University, including pictures illustrative of the biological work at that institution, were shown. The latter part of the talk was devoted to an account of a biological expedition to the little-known Island of Hainan. Insects from this island were exhibited. Mr. Hoffmann and the members (all Chinese) of the expedition lived (in the same houses) with the Aborigines (Wild Loi) in the mountains and learned much of these interesting but little-known people. Difficulty was experienced in penetrating to the interior of the island, which is an inhospitable land and has frequently brought death to those who would explore it. In fact, most of the members of the expedition were taken seriously ill with fever to which, unfortunately, one member succumbed. Professor Hoffmann is at present planning a further extensive expedition to the island. (Author's abstract.) A considerable number of lantern slides, panoramic views, periodicals and specimens were shown. Due to the lack of time there was no discussion of this paper.

The second communication on the program was by W. J. Nolan of the Bureau of Entomology, and was entitled "Recent Developments in Apiculture--With a Demonstration of the Artificial Insemination of Queen Bees." The artificial insemination of queen bees has long been a subject for investigation. Huber's work of over a century ago is a classic example. In spite of various reports of success in this field, the recent work of Dr. L. R. Watson at Cornell University along this line is the only such work which has been satisfactorily verified. The Watson method, which makes use of a micro-syringe in transferring the sperm from the drone to the queen bee, has been used successfully by others in the United States, Canada, and Russia. The first verification of Watson's method apparently was made in the U. S. Bureau of Entomology. (Author's abstract.) An informal demonstration of the subject matter was presented and explained in detail.

The meeting adjourned at 10.30 P. M.

J. S. WADE,
Recording Secretary.

Actual date of publication October 16, 1931.

PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 33 NOVEMBER, 1931 No. 8

FOUR NEW SPECIES OF MYMARIDAE FROM BRITISH COLUMBIA (HYMENOPTERA).

By OSCAR WHITTAKER.

The following descriptions are based on material collected by the author in western British Columbia. A paratype of each species has been placed in the United States National Museum. I take this opportunity of expressing my thanks to Dr. Gahan for supplying me with much valuable information on certain species of the genus dealt with below.

OOCTONUS, Haliday.

Ooctonus fuscipes, new species.

Female.—Black; scape and pedicel very dark brown, paler at extremities and beneath, flagellum black; legs dark brown, trochanters and extremities of femora and tibiae paler; tarsi brownish yellow, the apical two joints darker; petiole brownish yellow; wings subhyaline. Head about one and one-half times as wide as long, slightly wider than thorax, frons separated from vertex by a straight, transverse ridge; ocelli in a triangle, lateral ocelli further apart than from the eyes; occiput emarginate; vertex feebly sculptured, the sculpture in front of anterior ocellus very fine, behind the ocelli coarser and somewhat granular, frons smooth. Antennae two-thirds as long as forewings; scape about as long as pedicel and joints 3–5 combined; pedicel about one-quarter as long as scape; joint 3 very slightly shorter than pedicel; joints 4–9 subequal, as long as pedicel; joint 10 one and one-quarter times as long as preceding joint, about twice as long as thick; apical joint (club) slightly longer than preceding three joints combined, three and one-half times as long as wide. Thorax one and three-quarter times as long as wide. Pronotum, viewed from above, very short, appearing as a transverse, gently arcuate carina, invisible at the sides, produced in front in a tapering neck. Mesonotum with scaly-reticulate sculpture. Scutellum with a transverse, impressed, curved line, convex towards the base, the sculpture similar to that of the mesonotum posterior to the transverse line, finer in front of it. Metanotum smooth, the hind margin carinate. Propodeum smooth and polished, with a median carina which divides into two widely-divergent branches a short distance from the base and which, after running for about one-half the length of the propodeum, are obtusely angled and then converge but do not meet; on each side there is a lateral carina, these converge until reaching the angulation of the branches of the median carina, with which they are connected by a short transverse carina, and thereafter diverge; hind margin of

propodeum carinate. All pleurae smooth and polished. Mesopleura with a deep depression on its upper anterior part from which a deep groove runs to the base of coxa. Forewings two and one-half times as long as their greatest width, apically subtruncate, the marginal nerve reaching one-third the length of the wing, longest marginal cilia about one-seventh the wing's greatest width, the discal cilia in about twenty-eight rows. Hindwings about three-quarters as long as forewings, measured from hamuli to tip about ten times as long as wide, cilia on hind margin longer than the width of wing, those on the front margin shorter, with two irregular rows of cilia on the disc. Petiole subcylindrical, widest posteriorly. Abdomen highly polished.

Length, 1.25–1.3 mm.; *expanse*, 3.0–3.25 mm.

Described from four specimens from Hollyburn, 27th Aug.–19 Sept. 1928–30.

Ooctonus auripes, new species.

Female.—Black; scape and pedicel brown, the extremities paler; flagellum dark brown; petiole and legs, including coxae, yellow, apical joint of all tarsi dusky; wings hyaline. Head one and one-half times as wide as long, wider than thorax, narrowed behind eyes; occiput deeply emarginate; eyes large, remote from occiput; ocelli in a triangle, lateral ocelli further apart than from the eyes; vertex separated from frons by a transverse ridge, with inconspicuous, irregular sculpture, more distinct and transverse-linear between front ocellus and frontal ridge; frons smooth. Antennae about three-quarters as long as forewings; scape three and one-half times as long as pedicel, nearly as long as following four joints combined; pedicel and joints 3–5 equal, joints 6–8 about two-thirds as long as joint 3; joints 9 and 10 equal to joint 3, joint 10 nearly twice as long as thick; apical joint (club) as long as preceding three joints combined, nearly three times as long as wide. Thorax comparatively short and broad, one and one-third times as long as wide. Pronotum, viewed from above, very short, appearing as a gently arcuate, transverse carina, invisible at the sides, produced in a tapering neck; mesonotum and scutellum with alutaceous sculpture, the latter with the usual transverse, curved line; propodeum very short, smooth, with carinae as in *fuscipes*, the basal portion of median carina very short; all pleurae smooth and polished; upper part of mesopleura with a longitudinal groove, widened anteriorly. Forewings rather narrow, three and one-half times as long as their greatest width, the apex subtruncate; the marginal vein reaching about one-third the length of the wing; marginal cilia about one-seventh the wing's greatest width, discal cilia short, in about eighteen rows; hindwings two-thirds as long as forewings, measured from hamuli to tip nine times as long as wide, cilia on hind margin longer than the width of the wing, those on the front margin shorter, with two irregular rows of cilia on the disc. Abdomen highly polished.

Length, 0.90 mm.; *expanse*, 1.9–2.0 mm.

Described from two specimens from Chilliwack, 4 September and 15 October, 1926.

Ooctonus canadensis, new species.

Female.—Black; scape brownish-yellow; pedicel brown; flagellum darker brown, becoming black distally; petiole and legs, including coxae, yellow; wings subhyaline. Head one and one-half times as wide as long, a little wider than thorax; eyes large, remote from occiput; ocelli in a triangle, lateral ocelli further apart than from the eyes; occiput emarginate; vertex and frons separated by a transverse ridge; vertex before front ocellus almost smooth, the sculpture very fine and indistinct, with a fine, curved, impressed line running from the front ocellus to the eyes, behind which the sculpture is a little coarser. Antennae about three-quarters as long as the forewings; scape a little more than three times as long as pedicel, about as long as joints 3 and 4 combined; pedicel about three-fifths as long as joint 3; joint 3 half as long as scape; joints 4 and 5 equal, a little longer than joint 3; joints 6 and 7 each a little shorter than the preceding joint; joints 8 and 9 equal, a little shorter than joint 7; joint 10 three-quarters as long as joint 9, twice as long as thick; apical joint (club) as long as preceding two joints combined, three and one-half times as long as wide. Thorax twice as long as wide; pronotum plainly visible from above, front margin gently curved, carinate, humeral angles fairly prominent; mesonotum with fine, reticulate sculpture becoming somewhat linear on posterior part of median lobe, with a fine but distinct, longitudinal median, impressed line which becomes obsolete on the sloping anterior part; scutellum with the usual curved, transverse line, with very fine, irregular sculpture; metanotum smooth, hind margin carinate; propodeum long, smooth and polished, with carinae as in *fuscipes*, the undivided basal portion of median carina of considerable length; all pleurae smooth and polished; mesopleura with a shallow, longitudinal, impressed line on the upper part. Forewings about two and one-half times as long as their greatest width, the apex subtruncate, marginal nervure not quite reaching one-third the length of the wing, marginal cilia short, about one-eighth the wing's width, discal cilia short, in about thirty rows. Hindwings three-quarters as long as forewings, measured from hamuli to tip about eleven times as long as wide, cilia on hind margin longer than width of wing, those on front margin shorter, with three irregular rows of discal cilia. Petiole long, widest posteriorly. Abdomen highly polished, nearly as long as thorax, twice as long as wide, the apex obtusely conical, ovipositor exserted.

Length, 1.4 mm.; *expanse*, 3.3 mm.

Described from two specimens from Hollyburn, 31 August and 7 September, 1930.

Ooctonus occidentalis, new species.

Female.—Black; scape yellow, pedicel and joint 3 brownish-yellow, remaining flagellar joints dark brown, becoming black distally; petiole and legs, including coxae, yellow, pulvilli dusky; wings subhyaline. Head one and one-half times as wide as long, wider than thorax; occiput emarginate; eyes large, remote from occiput; ocelli in a triangle, lateral ocelli further apart than from the eyes; frons smooth and polished, separated from vertex by a transverse ridge; vertex feebly wrinkled before front ocellus, behind this with the sculpture somewhat granular.

Antennae three-quarters as long as forewings; scape as long as following three joints combined; pedicel a little less than one-quarter as long as scape; joint 3 one and one-half times as long as pedicel; joints 3–7 subequal; joints 8 and 9 very slightly shorter; joint 10 very slightly shorter than joint 9, about one and one-quarter times as long as pedicel, twice as long as thick; apical joint (club) slightly more than three times as long as wide, nearly as long as preceding three joints combined. Thorax one and three-quarter times as long as wide; pronotum distinctly visible at the sides, separated from the long neck by a gently arcuate carina; mesonotum with fine but distinct alutaceous sculpture, without a median, impressed line as in *canadensis;* scutellum with the usual, transverse, curved line, with similar sculpture to that of the mesonotum, that on the basal area a little finer than that on the distal area; metanotum smooth, hind margin carinate; propodeum long, smooth and polished, with a median bifurcate carina and lateral carinae, the basal part of median carnia fairly long, the lateral carinae meeting the branches of median carina without connecting transverse carinae; all pleurae smooth and polished; mesopleura with a fine, longitudinal, impressed line on the upper part. Forewings two and one-half times as long as their greatest width, apically subtruncate; marginal nervure reaching about one-third the length of the wing; marginal cilia about one-eighth the wing's width, discal cilia in about thrty two rows. Hindwings about two-thirds as long as forewings, measured from hamuli to tip nine times as long as wide, cilia of hind margin a little longer than width of wing, those on front margin shorter, with three irregular rows of discal cilia. Petiole about four times as long as wide, widest posteriorly. Abdomen somewhat shorter than thorax, twice as long as wide, apex obtusely conical, ovipositor exserted.

Length, 1.5 mm; *expanse,* 3.5 mm.

Described from two specimens from Hollyburn, 18 July, 1928 and 31 August, 1930.

KEY TO NEARCTIC SPECIES OF OOCTONUS.

1. Varicolored; forewings with a dusky cross-stripe.......... *morilli* Howard.
   Black; forewings without a cross-stripe .... 2.
2. Forewings extraordinarily wide.......... *quadricarinatus,* Girault.
   Forewings not extraordinarily wide .... 3.
3. Antennal joint 3 not or only a little longer than pedicel .... 4.
   Antennal joint 3 distinctly longer than pedicel.......... 7.
5. Legs yellow.......... *auripes,* Whitt.
   Legs dark.......... 5.
5. Antennal joint 3 distinctly longer than joint 4.......... *silvensis,* Girault.
   Antennal joint 3 subequal to joint 4 .... 6.
6. Antennal joint 6 considerably shorter than joint 5; joints 7 and 8 still shorter.......... *americanus,* Girault.
   Antennal joints 5–8 subequal.......... *fuscipes,* Whitt.
7. Mesonotum with a fine, longitudinal, impressed line, obsolete anteriorly.......... *canadensis,* Whitt.
   Mesonotum without such line.......... *occidentalis,* Whitt.

A NEW SPINNING MITE ATTACKING RASPBERRY IN MICHIGAN.

By E. A. McGregor,
Of the Bureau of Entomology, United States Department of Agriculture.

During the past few years, at various times Prof. R. H. Pettit of Michigan State College has sent to the writer specimens of mites attacking raspberry in southwestern Michigan. Two species have been involved, a Paratetranychus and a Tetranychus. The latter proves to be new to science, and is herein described.

Tetranychus mcdanieli, new species.

Female.—General body color deep amber, with blackish spots distributed chiefly around body margin; legs about same color as body. A single pale eye cornea on each side, behind and outward of subfrontal bristles. Body oval, in length averaging 0.40 mm.; width, averaging 0.24 mm. Dorsal body setae 26, pale, roughly in four rows. Mandibular plate rounded anteriorly with no noticeable emargination. "Thumb" of palpus fully as wide as long, bearing at its tip a strong "finger" whose base is nearly half the width of "thumb" at tip; on its upper distal corner are two pin-shaped pseudo-fingers; on upper side hardly midway to base is a "finger" or sensilla much smaller than terminal "finger," and between this and base are two strong setae somewhat exceeding the sub-basal "finger"; a strong hair arises latero-ventrally half way from tip to base of "thumb." Claw on the penultimate joint of palpus less hooked than usual, hardly reaching subbasal "finger." The forelegs are about three-fourths the length of the body. Femur about three times as long as thick, just equalling the tarsus; tibia about one-fifth longer than petella, which is nearly twice as long as trochanter. Relative lengths of joints as follows: Coxa, 21±; trochanter, 11; femur, 35; patella, 19; tibia, 23; tarsus, 35. Tip of tarsus bearing a claw which is bent downward at about right angles at a point one-quarter outward from base; basal portion uncleft, but distal portion made up of six component, subequal, straightish spurs. The usual series of four tenent hairs arise in pairs by the side of the claw base. The collar trachea is of the orthodox Tetranychus type, in the shape of a U with one long and one short arm.

Male.—Body more wedge-shaped than female, in length much smaller: legs proportionately longer. Penis with inner lobe probably rod-like (extremely difficult to observe); basilar lobe rudimentary; shaft about twice as long as its basal thickness, bent abruptly upward and forward about 330° from axis of main shaft, then bent sharply backward as a sickle-shaped acuminate point, the distal portion thus forming a double or S-shaped hook.

Type slide.—Cat. No. 1029, U. S. N. M.

The type material is from Bridgman, Michigan, June 19, 1930, from cultivated raspberry foliage, Lot 1533, Sub. 49, Dept. of Entomology, Michigan State College. The same species has been received from the same host from Byron Creek, Michigan

(Lot 1533, Sub. 50). Professor Pettit informs me that the mite appears at berry-picking time during dry seasons and that the epidemics are so severe as nearly to wipe out the raspberry crop in southwestern Michigan. Since the raspberry crop is attacked during ripening time, it is impractical to apply insecticides to the crop at this time. Professor Pettit describes the damage as follows: "The leaves turn brown, curl somewhat, and during the latter part of the picking season the fruit fails to develop properly. The new growth is webbed together, the leaves being bound together by silken webs. The mites work on both the under and upper surfaces of the leaves." Professor Pettit states that the damage amounts to many thousands of dollars during epidemics and that the pest has been reported for 10 or 12 years. The mites usually disappear soon after the crop is harvested.

The present species is possibly closest to *T. bimaculatus* Harv., from which it may be distinguished as follows:

T. bimaculatus. Female: Color usually brick or ferruginous red; mandibular plate with slight median anterior notch; femur noticeably exceeding tarsus. Male: Penis with strongly developed basilar lobe, shaft bent upward at about 90°, ending in a very blunt barb.

T. mcdanieli. Female: Color usually deep amber; mandibular plate with no anterior emargination; femur equalling tarsus. Male: Penis with almost no basilar lobe, shaft bent upward and forward about 330° from axis of shaft, then bent sharply backward as a sickle-shaped acuminate point, the distal portion thus forming an S-shaped hook.

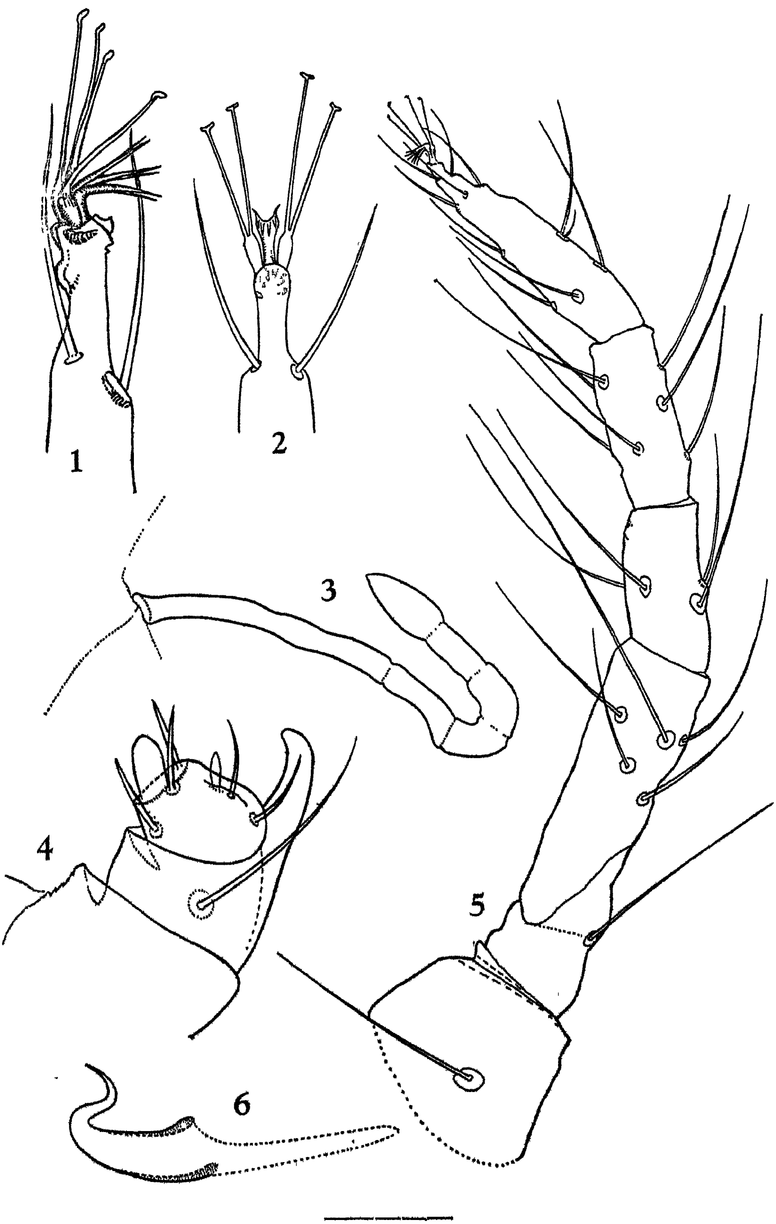
The Paratetranychus, also occurring on raspberry in Michigan, appears to be *P. ilicis* McGregor. This species was originally described from holly (*Ilex opaca*) from South Carolina.

EXPLANATION OF PLATE.

Tetranychus mcdanieli.

Fig. 1. Tip of tarsus showing appendages (viewed laterally).
Fig. 2. Tip of tarsus (viewed ventrally).
Fig. 3. Collar trachea (viewed laterally).
Fig. 4. Distal portion of palpus with terminal appendages (viewed laterally).
Fig. 5. Foreleg (viewed laterally).
Fig. 6. Penis (viewed laterally).

(All drawings made with assistance of camera lucida, using oil-immersion lens for Figs. 1, 2, 3, 4 and 6.)


1
2
3
4
5
6

A NEW PINE MOTH FROM CONNECTICUT.

By Carl Heinrich,
Bureau of Entomology, U. S. Department of Agriculture.

Eucosma gloriola, new species.

A small coppery-red species with two shining, metallic, lead gray transverse fasciae; and (in male) with rolled-over costal fold extending to middle of fore wing and enclosing a hair pencil.

Palpus dark gray; inner side paler, with a patch of yellowish white scales at end of second joint. Head yellowish cream white. Thorax dull silvery gray with some copper scaling on anterior half of tegula. Fore wing coppery red, somewhat darker along costa and toward base and with a rather broad coppery ocherous shade along termen; a faint transverse lining of metallic leaden scales near base; from basal third of costa and extending to mid-dorsum a pale transverse fascia, consisting of two rather broad parallel lines of shining leaden-metallic (mixed with some white) scales and separated by a line of the red ground color; beyond this a similar narrower fascia extending from costa just beyond middle toward tornus, thinning out and fusing into the coppery-ocherous terminal area at tornus; extreme edge of costa black; cilia grayish with a fine black subbasal line, the latter broken in some female specimens by white dashes. Hind wing dark grayish fuscous, rather coarsely scaled; cilia pale grayish with a darker basal band.

Genitalia (male and female) as in *sonomana* Kearfott, but much smaller.

Alar expanse, 12–15 mm.

Type and paratypes.—Cat. No. 43654 U. S. N. M.

Type locality.—Stamford, Conn.

Food Plant.—White pine (*Pinus strobus*).

Described from male type and two male and three female paratypes all from the type locality. These specimens were received from Dr. E. P. Felt, who states that they were reared from larvae feeding in the tips of white pine twigs.

The moths issued May 1, 4, 7, and 12, 1931, from larvae collected on July 9, 1930.

The species is very similar and closely related to the western *sonomana* Kearfott. It differs chiefly in size and a few details of pattern. In *sonomana* the outer fascia of the fore wing is more irregular and has a white inner line where it fuses into the tornal ocherous patch; this is entirely lacking in *gloriola*. Kearfott's species also has the coppery-ocherous band along termen deeply angulated. In *gloriola* this is of nearly equal width from apex to tornus. The genitalia of *gloriola* are about half the size of those of *sonomana*. It is barely possible that *gloriola* is a food-plant and eastern local race of Kearfott's species, but this is extremely doubtful. It resembles nothing else in the family except, superficially, some of the smaller *Rhyacionia*, from which it is at once distinguished by its costal fold and different genitalia.

The larva is sordid white with pale yellow thoracic and anal shields. Skin coarsely and evenly scobinated. Head yellowish brown with a round blackish spot at incision of lateral hind margin. Ninth abdominal segment with paired setae II on separate pinacula; VI well separated from IV and V and on a separate pinaculum. Proleg crochets small, uniordinal (10 to 12), arranged in a complete circle weakened or partially broken outwardly.

NEW CACTUS BEETLES, III.[1]

By W. S. Fisher, *U. S. Bureau of Entomology.*

This is the third paper on the beetles received in connection with the prickly-pear insect investigations that are being conducted by the Commonwealth of Australia at Uvalde, Texas. The specimens were sent for identifications by Ronald C. Mundell, who is anxious to have names for the new species to use in papers dealing with cactus insects.

Moneilema (Collapteryx) crassipes, n. sp.

Male.—Moderately large, elongate, strongly convex, subopaque, glabrous, and uniformly black.

Head feebly, broadly depressed between the antennal tubercles, with a narrow, longitudinal groove extending from epistoma to occiput, vaguely, finely, rather densely punctate, with a few coarse, irregularly distributed punctures intermixed, and rather densely clothed with short, recumbent, inconspicuous, black pubescence; clypeal suture entire, and rather strongly impressed. Antenna about two-thirds as long as the body, rather robust, gradually tapering to the apex, uniformly clothed with inconspicuous pubescence, and the joints not annulated with white pubescence; first joint long, robust, gradually expanded to apex, which is truncate, and the surface finely, inconspicuously punctate, with a few coarse, vague punctures intermixed.

Pronotum distinctly wider than long; sides strongly sinuate anteriorly, feebly expanded at middle, strongly constricted along basal third, and armed on each side just behind the middle with a short, obtuse tubercle; surface with a vague, longitudinal, median groove on basal half, rather densely, obsoletely punctate, with a few inconspicuous, irregularly distributed, coarse punctures intermixed, a transverse row of coarse, deep punctures along the base, and rather densely clothed with short, recumbent, inconspicuous, black pubescence.

Elytra nearly twice as long as wide, widest at middle, oblong-oval, strongly convex, the flanks rather abruptly deflexed and vertical; sides broadly rounded at humeral angles, and broadly, transversely subtruncate at apices; surface rather densely clothed with short, recumbent, inconspicuous, black pubescence,

---

[1]I. Proc. Ent. Soc. Wash., vol. 28, 1926, pp. 214–217.
II. Proc. Ent. Soc. Wash., vol. 30, 1928, pp. 1–7.

and coarsely, deeply, sparsely, irregularly punctate basally, the punctures becoming sparser toward the apices.

Abdomen slightly convex, sparsely clothed with short, recumbent, black pubescence (longer and semierect on last segment), rather densely, obsoletely punctate, with a few coarse punctures intermixed, especially on the last segment, which is entirely black, and rather deeply, broadly, arcuately emarginate at apex. Mesosternum nearly flat between the coxae. Legs robust, and the femora strongly expanded toward the apices, and the surface with a few scattered, coarse punctures; first joint of posterior tarsus with a large, triangular, pubescent, pad on each side at apex, and the second and third joints with a pubescent pad covering the entire surface.

Female.—Differs from the male in having the last abdominal segment broadly rounded at apex, the femora more slender, and the elytra smooth, sometimes longitudinally wrinkled, but without coarse punctures.

Length, 15–22 mm.; width, 5.5–10 mm.

Type locality.—Palmillas, Tamaulipas, Mexico.

Type, allotype, and paratypes.—Cat. No. 43673, United States National Museum. *Paratypes* returned to Mr. Ronald C. Mundell.

Described from thirty-two examples, twenty-five males (one type), and seven females, collected at the type locality, August 10, 1930, and June 15, 1931, by Ronald C. Mundell.

This species shows considerable variation in size. In some examples the mesosternum is nearly flat between the coxae, whereas in other examples it is deeply, longitudinally grooved. In some of the examples there is a small spot of dense, whitish pubescence on each of the middle and posterior coxae, but these spots are denuded in most of the examples examined. There is considerable variation in the sculpture on the elytra, some of the examples having the surface smooth (punctate in the males), whereas in most of the examples examined the surface is more or less longitudinally wrinkled.

This species is allied to *crassa* LeConte, but it differs from that species in having the sides of the elytra more abruptly deflexed, the joints of the antennae not annulated with white pubescence at bases, and the first joint of the posterior tarsus not entirely covered by the pubescent pad.

Moneilema (Collapteryx) aterrima, n. sp.

Male.—Rather small, elongate, strongly convex, subopaque, uniformly black, and the elytra variegated with whitish pubescence.

Head feebly, broadly depressed between the antennal tubercles, with a narrow, longitudinal groove extending from epistoma to occiput, vaguely, densely, finely punctate, with a few inconspicuous, coarse punctures intermixed, sparsely clothed with short, recumbent, inconspicuous, whitish pubescence, which is denser behind the eyes; clypeal suture feebly impressed. Antenna about two-

thirds as long as the body, rather robust, gradually tapering to the apex, uniformly clothed with short, recumbent, brownish pubescence, and the third and fourth joints clothed with more or less distinct whitish pubescence on the underside; first joint long, robust, gradually expanded to the apex, which is truncate, and the surface finely, inconspicuously punctate, with a few coarse, vague punctures intermixed.

Pronotum slightly wider than long; sides nearly parallel, slightly sinuate, vaguely expanded at middle, and armed on each side just behind the middle with a short, obtuse tubercle; surface feebly, narrowly, transversely depressed along base, finely, obsoletely punctate, with a row of coarse, deep, irregularly distributed punctures along the base and anterior margin, and sparsely clothed with short, recumbent, inconspicuous, whitish pubescence.

Elytra nearly twice as long as wide, widest at middle, oblong-oval, strongly convex, the flanks rounded and not very abruptly deflexed; sides broadly rounded at humeral angles, and broadly subtruncate at apices; surface sparsely clothed with short, recumbent, inconspicuous, brownish pubescence, variegated with whitish pubescence, more or less longitudinally rugose basally, and coarsely, deeply, sparsely, irregularly punctate, the punctures more or less arranged in single rows between the rugae.

Abdomen rather strongly convex, finely, obsoletely punctate, sparsely clothed with short, recumbent, whitish and yellowish pubescence, giving the surface a variegated appearance; last segment feebly, broadly, arcuately emarginate at apex. Mesosternum deeply, narrowly grooved in its entire length. Legs robust, the surface with a few scattered, coarse punctures, and the femora strongly expanded toward the apices; first joint of posterior tarsus with a large, triangular pubescent pad on each side of apex, and the second and third joints with a pubescent pad covering the entire surface.

Female.—Differs from the male in having the upper surface uniformly clothed with short, recumbent, inconspicuous, brownish pubescence, not variegated with white pubescence, last abdominal segment broadly rounded at apex, and the femora more slender.

Length, 13 mm.; width, 5 mm.

Type locality.—San Luis Potosi, Mexico.

Type, allotype, and paratype.—Cat. No. 43674, United States National Museum. *Paratype* returned to Mr. Ronald C. Mundell.

Described from four examples, three males (one type), and one female, collected on *Opuntia* sp. at the type locality, during May, June, and July, 1930, and May 20, 1931, by Ronald C. Mundell, who reports the species extremely rare.

There is scarcely any variation in the examples examined, except that the two paratypes are larger than the type or allotype, measuring 19 millimeters in length and 8 millimeters in width.

This species is allied to *variolare* Thomson, but it differs from that species in having the pronotum punctured only along the base and anterior margin, the surface of the elytra longi-

tudinally rugose, and the punctures more or less arranged in single rows between the rugae.

Moneilema (Collapteryx) mundelli, n. sp.

Male.—Large, robust, strongly convex, subopaque, uniformly black, and ornamented with distinct, irregular, white pubescent markings.

Head broadly, rather deeply concave between the antennal tubercles, with a narrow, longitudinal groove extending from epistoma to occiput, vaguely, finely, densely punctate, with numerous shallow, coarse punctures intermixed, rather densely clothed with short, recumbent, inconspicuous, blackish pubescence, and ornamented with a V-shaped, brownish-white pubescent fascia between the antennal tubercles; clypeal suture feebly impressed, and abbreviated at the sides. Antenna about two-thirds as long as the body, robust, gradually tapering to the apex, uniformly clothed with short, recumbent, inconpsicuous, blackish or brownish pubescence, the third and fourth joints vaguely annulated with white pubescence on the underside at bases; first joint long, robust, gradually expanded to the apex, which is truncate, the surface finely inconspicuously punctate, with a few coarse, vague punctures intermixed.

Pronotum distinctly wider than long; sides nearly parallel, feebly sinuate, vaguely expanded at middle, and armed on each side near middle with a short, obtuse tubercle; surface finely, densely, obsoletely punctate, with numerous coarse, irregularly distributed punctures intermixed, densely clothed with short, recumbent, inconspicuous, black pubescence, and ornamented with distinct, irregular, white pubescent markings.

Elytra nearly twice as long as wide, widest near middle, oblong-oval, strongly convex, the flanks broadly rounded but not abruptly deflexed; sides broadly rounded at humeral angles, and conjointly, broadly rounded at the apices; surface sparsely, coarsely, irregularly punctate basally, the punctures becoming sparser toward the apices, more or less longitudinally wrinkled, densely clothed with short, recumbent, inconspicuous, black pubescence, and ornamented with white pubescent markings similar to those on the pronotum.

Abdomen slightly convex, finely, densely, obsoletely punctate, with a few coarse punctures intermixed, sparsely clothed with short, recumbent, inconspicuous, black pubescence, with a few small spots of white pubescence toward the sides of the segments; last segment broadly, deeply, arcuately emarginate at apex. Mesosternum broadly, deeply grooved in its entire length. Legs robust, the surface with a few scattered, coarse punctures, somewhat rugose, and the femora strongly expanded toward the apices; first joint of posterior tarsus with a pubescent pad covering the apical half, the second and third joints with a similar pad covering the entire surface.

Female.—Differs from the male in having the last abdominal segment broadly rounded at the apex, and the femora more slender.

Length, 18–23 mm.; width, 8–10 mm.

Type locality.—Gonzalez, Tamaulipas, Mexico.
Other localities.—Villa Juarez and Tampico, Tamaulipas, Mexico.

Type, allotype, and paratypes.—Cat. No. 43675, United States National Museum. *Paratypes* returned to Mr. Ronald C. Mundell.

Described from fourteen examples, nine males (one type), and five females, all of which were collected by Ronald C. Mundell, who writes that this species is not restricted to any particular form of cactus. The type, allotype, and three paratypes collected at the type locality, April 21, 1931, seven paratypes collected at Villa Juarez (southeast of Ciudad Victoria, on the new Pan-American Highway), April 15, 1931, and two paratypes collected at Tampico, April 16, 1931.

There is a slight variation in the size, but the white pubescent markings are rather constant. In a few of these examples these markings are slightly wider, and in one of the paratypes from Tampico the markings are more or less confluent.

This species resembles *ulkei* Horn and *albopictum* White. From the former it differs by both sexes having the white pubescent markings on the elytra, and from *albopictum* in having the flanks of the elytra broadly rounded, and not abruptly deflexed as in that species.

This species is named in honor of Ronald C. Mundell, through whose careful and energetic collecting our knowledge of the species of *Moneilema* of Mexico has been very greatly increased.

A PECULIAR PANGURGINE BEE FROM ARIZONA.

By T. D. A. Cockerell.

On Sept. 1, 1930, Mr. P. H. Timberlake collected four small black bees at flowers of *Sideranthus gracilis* (Nuttall), also called *Aplopappus gracilis*, at Prescott, Arizona. Examining them he was surprised to see immediately above each eye a rounded shining prominent tubercle, while the ocelli were placed on the front of a large shining elevation. As the bee belongs to the genus *Pseudopanurgus*, in which I have been specially interested, Mr. Timberlake has very kindly transmitted the specimens to me for description.

Pseudopanurgus timberlakei n. sp.

♀. So closely related to *P. fraterculus* (Ckll.) that at first it seemed to be a mere local race of that species. There are, however, enough characters to indicate a distinct species.

The facial foveae are broader and longer; the region above them is shining, and not strongly punctured. (In *fraterculus* the foveae are shorter and rather

narrower, the upper end about level with the lower side of supraorbital tubercle, while the region just above each fovea is strongly punctured.)

The supraorbital tubercles and ocellar elevation are more developed than in *P. fraterculus*.

The clypeus has no median groove, or if a groove is indicated, it is punctured like the rest of the surface. (In *fraterculus* the clypeus has a narrow shining median groove.)

The basal area of metathorax has distinct but very fine plicae or raised lines all over. (In *fraterculus* it is without such plicae, and is very sparingly punctate.)

The wings have the basal half hyaline, the apical half or less grayish-brown. (Wings strongly reddened throughout in *fraterculus*.)

Both have a pale spot at base of anterior and middle tibiae; both have the tegulae with an anterior depressed, darkened punctate portion, and a large convex, impunctate, light brown posterior portion, the light brown also extending anteriorly along the sides.

In *P. scaber* (Fox) the area of the metathorax is plicate, and the wings are darkened apically, but there is no mention of cephalic tubercles, and the clypeus has a longitudinal depressed line. *P. mexicana* (Cress.) differs by the apex of the flagellum testaceous beneath and the thorax coarsely and much more closely punctured. *P. rugosus* (Rob.), from Illinois, has no impressed line on clypeus, but is otherwise distinct from *P. timberlakei*. The other species, *P. aethiops* (Cres.) (*fuscipennis* Crawf.), *P. pectidellus* Ckll., *P. cameroni* (Baker), and *P. andrenoides* (Smith), are quite distinct. These insects belong to the restricted and true genus *Pseudopanurgus*, as I understand it.

In *P. timberlakei* the labrum has a dense brush of long golden hair at its apex; the first joint of labial palpi is longer than the other three united. Of the four specimens, the holotype goes to the U. S. National Museum, one is retained by Mr. Timberlake, one remains in my collection and one goes to the British Museum.

Type No. 43582, U. S. N. M.

THE TYPE LOCALITY OF DIASTATA ALBIBASIS MALLOCH.

By T. D. A. Cockerell.

The type of the species (described in Proc. U. S. Nat. Mus. 78, art. 15, 1931, p. 30) is said to have been collected by myself "Near Ledoux, N. M." I fear my writing on the label was not clear, but at my request Dr. Aldrich has looked at it, and it is "Near Lea Lake, N. M." The place is not far from Roswell, in the Pecos Valley.

REVIEW OF WILLIAMS'S "THE INSECTS AND OTHER INVERTEBRATES OF HAWAIIAN SUGAR CANE FIELDS."

By J. S. WADE.

"Handbook of the Insects and Other Invertebrates of Hawaiian Sugar Cane Fields," compiled by Francis X. Williams, et al., Experiment Station of the Hawaiian Sugar Planters' Association, Honolulu, Hawaii. Octavo, cloth, 400 pages, 190 figs., 41 pls., bib., 1931.

This handbook is mainly a compilation. The introduction was written by the late Dr. F. A. G. Muir, and there are chapters on the fauna of sugar cane fields; on nematodes attacking sugar cane roots, by R. H. Van Zwaluwenburg; and a chapter on records of introduction of beneficial insects into Hawaiian Islands, by O. H. Swezey. According to the "Foreword," data have been obtained chiefly from local publications and from records on sugar cane insects and other insects, prepared by Albert Koebele, R. C. L. Perkins, G. W. Kirkaldy, D. L. Van Dine, O. H. Swezey, F. Muir, F. W. Terry, D. T. Fullaway, J. F. Illingworth, P. H. Timberlake, C. E. Pemberton, R. H. Van Zwaluwenburg, and others.

The extensive reference collection of insects at the experiment station has been found to be of great assistance in preparation of this work, while much miscellaneous information has been gathered from text books on entomology and from various publications treating of sugar cane insects in other parts of the world. While a portion of the illustrations have been take from other publications, a number have been prepared for the present work by W. Twigg-Smith, illustrator for the experiment station, and by James Yamamoto.

In addition to the introductory matter, there are subdivisions covering treatment of sugar cane insects that are or have been serious pests; of some sugar cane insects that are pests of less importance, and of the relation of invertebrates to sugar cane in Hawaii. The general structure and development of insects include quite a full discussion of all of the various orders of insects under consideration, occupying pages 39–308, with numerous illustrations. Attention also is given to enemies of the nut grass, *Cyperus rotundus;* the Myriapoda; the soil fauna of sugar cane fields; nematodes attacking sugar cane roots, as already mentioned, and summary of introduction of beneficial insects into the Hawaiian Islands. A bibliography of 13 pages is appended. It is believed that this publication will be useful for the purpose for which it has been prepared and will be of service as the compilers hope, to "serve as a basis for future work that will make our knowledge of sugar cane entomology in Hawaii more complete."

LINGNAN SCIENCE JOURNAL, VOL. 7, JUNE, 1929, *Lingnan University, Canton, China.*

The entomological portion of this volume contains some 431 pages of matter relating to insects. The articles deal with a variety of subjects but the general trend of the publication is toward the taxonomic phases of the science. Some ten orders of insects are discussed, with the Coleoptera in the majority. There are, however, several extensive and interesting papers treating other orders of insects. Notable among these are: "Gall Midges or Gall Gnats of the Orient, by E. P. Felt, comprising about 60 pages; Termites and Man's Fight Against Them, by T. E. Snyder, 50 pages; The Cricket-Locusts (Gryllacrids) of China by H. H. Karny, 36 pages, the last two being fully illustrated.

Biology, morphology and the economic aspects of Oriental insects share in the discussions and the volume ends with a paper entitled "The Life History of Rhyncocoris Humeralis Thunb. (Hemiptera, Pentatomidae)" by William E. Hoffmann, head of the biology department in Lingnan University, who is most pleasantly remembered by many members of this society as a visitor of the past year. —W. R. W.

MINUTES OF THE 430th MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, JUNE 4, 1931.

The 430th meeting of the Entomological Society of Washington was held at Takoma Park, Md., Laboratory of the U. S. Bureau of Entomology, on June 4, 1931. Dr. F. L. Campbell and staff members of the laboratory invited the membership of the Society and their guests to come at 6 P. M. and attend a picnic supper. The formal meeting began at 8 P. M. Dr. A. C. Baker, President, presided. Those in attendance who registered comprised 48 members and 62 visitors.

Under the heading "Reports of Committees," Mr. S. A. Rohwer presented a resolution endorsed by the committee on Nomenclature. In addition to being endorsed by the nomenclature committee of the Entomological Society, the resolution also was endorsed by the committee for the Biological Society of Washington, the Geological Society of Washington, the American Ornithologists' Union, the Helminthological Society of Washington, the American Society of Mammalogists and the American Society of Parasitologists, and by a single member of the group appointed by three national societies: The American Malacological Union, American Association for the Advancement of Science, Sec. F, and American Society of Zoologists. The resolution dealt with the action taken at the International Zoological Congress at Padua, Italy, in the summer of 1930. This action, in the judgment of the committee, establishes a precedent

which jeopardizes the stability of zoological nomenclature. The resolution, endorsed by the committee, follows: "We, the undersigned, members of the committees on nomenclature of the various scientific societies listed below, view with alarm the action taken on the Horn Resolution at the International Zoological Congress held in Padua, Italy, in 1930, and consider that this action establishes a precedent which seriously jeopardizes the stability of zoological nomenclature. The adoption of the Horn Resolution by the Congress was contrary to the 1901 agreement, which provided that proposals regarding the international rules of zoological nomenclature would not be submitted to the Congress without the unanimous recommendation of the International Commission on Zoological Nomenclature. We believe that the passage of the Horn Resolution was unparliamentary, contrary to the methods of procedure approved by the International Commission on Zoological Nomenclature, and, consequently, invalid. We, therefore, reaffirm our adherence to the international rules of zoological nomenclature as constituted under the 1901 agreement. Edward A. Chapin, Hartley H. T. Jackson, Gerritt S. Miller, Harry C. Oberholser, Biological Society of Washington; J. Bridge, W. P. Woodring, Geological Society of Washington; A. C. Baker, Carl Heinrich, Harold Morrison, Entomological Society of Washington; T. S. Palmer, Charles W. Richmond, American Ornithologists' Union; Benjamin Schwartz, Eloise B. Cram, Helminthological Society of Washington; Arthur H. Howell, American Society of Mammalogists; G. Steiner, American Society of Parasitologists; and Paul Bartsch, American Malacological Union, American Association for the Advancement of Science, Sec. F, American Society of Zoologists." Mr. Rohwer moved that the Society confirm the action of its committee on nomenclature and adopt the resolution. The motion was seconded. In debate Dr. Aldrich asked the speaker to outline the action taken by the Zoological Congress which the committee looked upon with so much alarm. In response, Mr. Rohwer briefly reviewed the principles endorsed at the International Congress held in 1901 which provided that no questions of nomenclature would be brought before the general Congress for vote until they had the unanimous endorsement of the International Commission of Zoological Nomenclature. This action was believed to be sound and logical because it prevented the general session of the Congress which was dominated by the zoologists of the country in which the individual congress was held from acting on questions of nomenclature until the commission had fully considered the question. The International Commission of Zoological Nomenclature, although selected by the Congress, is composed of representatives of all the larger countries. Members of the Commission are selected because of their knowledge of the subjects, are supposed to, and actually do consider questions of zoological nomenclature from the legal aspect, as well as the wishes of the members of the zoological profession of the country which they represent. Questions of nomenclature can not be settled by off-hand decisions. They require intensive study, are often of far-reaching importance and affect systematic zoology throughout the world. He pointed out that at the various Congresses it was impossible to have representatives from all the countries and that the purpose of having an international commission was to give the zoologists of all countries an opportunity to express through their representatives their

opinions on zoological questions. This method provided to the zoologists of the world ample opportunity to debate questions of nomenclature, and when the commission was unanimous it was at least reasonably certain that the action recommended would have the endorsement of the zoologists as a whole. The resolution adopted at the International Congress in Padua, while in itself of comparatively little moment, broke a precedent inasmuch as the general Congress considered a matter of nomenclature which did not have the endorsement of the Commission. Doctor Aldrich dissented from the explanation of Mr. Rohwer and read a translation of the actual motion proposed by Dr. Horn and adopted at Padua by the Section of Nomenclature and the Congress, as follows: "The Congress may determine that only those publications shall be accepted as agreeing with the principles of binary nomenclature, in which the use of a single word for a genus name and a single word for a species name is consistently carried out."

Inasmuch as the Congress did not so determine, the Code and opinions remain just as before. The speaker stated that he had sent a copy of Science containing Dr. Stiles's article on the Padua incident to Horn, Jordan and Poche, inviting them to write him their views on the matter for presentation at our Society when the present resolution should be offered for adoption. The time has been so short that he was able to present only a letter from Dr. Jordan, which contained however an outline of the Padua incident. Dr. Jordan wrote that Dr. Bather had sent a letter to Science, which also expressed his own views, answering Dr. Stiles's article. The time had been so short that this was still unpublished.[1] As a matter of courtesy to our European colleagues, and in order that our members might better understand their position before voting on the resolution, Dr. Aldrich moved that the consideration of the resolution be postponed until our next meeting, which was seconded.

The President, Dr. Baker, spoke briefly, explaining that when the resolution was presented at a recent meeting of the membership of all of the committees who had met to consider the action taken at the Zoological Congress, it was pointed out that it would be highly desirable that early action be taken inasmuch as many of the Societies would hold their meetings in late summer or early autumn. For that reason those who had endorsed the resolution would be glad to have it given early consideration. He asked Dr. Howard whether he wished to discuss the motion. Dr. Howard spoke briefly on the manner in which zoological congresses transact their business and urged the immediate adoption of the resolution. Dr. Aldrich's motion to postpone action had been seconded, was lost, and a vote taken on the original motion—i. e., the endorsement of the action taken by the Society's committee on nomenclature—resulting in the adoption of the motion with one dissenting vote, that of Dr. Aldrich.

The first paper on the regular program was given by Dr. Howard and was entitled, "The Sort of Talk you would Naturally Expect from a Surviving Founder." Dr. Howard stated that the Entomological Society of Washington at its first meeting, called by Professor Riley, Mr. Schwarz and himself, had only 9 people present and that only 25 signed the constitution. These included

[1]Published in Science for June 5—see "Is an International Zoological Nomenclature Practicable?", Science, vol. 73, no. 1901, June 5, 1931, pp. 612-613.

men from Washington, Baltimore and the surrounding country. Of these 25 he had saved contemporary pictures of 15 and he placed in the hands of the secretary a brief statement of his recollections of the 10 of whom he did not have photographs. The statement is as follows: "Memorandum concerning original members of the Entomological Society of Washington of whom no photographs are in the Bureau collection. (a) T. Eugene Oertel. He was a young man, slightly interested in an amateurish way, who left Washington after a year or so and went to Georgia; and none of us have ever heard of him since. (b) Laurence C. Johnson. Judge Johnson was a man of over 50 who had been an agent of the Entomological Commission and afterwards of the Division in the study of the cotton caterpillar in Mississippi. He lived at Holly Springs and was much interested in entomology. At the time of the founding of the Society he was on a visit to Washington. (c) John Murdock. He was a small man, in his early thirties I should say, a graduate of Harvard, who had gone to Point Barrow, Alaska, for the U. S. Signal Service and made extensive entomological and anthropological collections up there. At the time of the founding of the Society he was working in the Smithsonian Institution, writing up his reports. Later he became Librarian of the Smithsonian, and at one time held the chair of Zoology in the University of Wisconsin while E. A. Birge was in Japan. Later he became assistant in the Boston Public Library, and died there ten years or more ago. (d) W. S. Barnard was a tall, slender, blond man, at least six feet three in height and with a full beard. He had been a professor in Iowa, an inspector at Pennikese under Agassiz, and had Comstock's chair at Cornell while Comstock was in Washington. At the time the Society was founded he was working under C. V. Riley on machinery for the distribution of arsenical poison on the cotton caterpillar. He was the inventor of the so-called cyclone nozzle, later known in Europe as the Vermorel nozzle. (e) B. Pickman Mann. An eccentric man, graduate of Harvard, a former editor of *Psyche*, who came to Washington in 1880 to work on a bibliography of economic entomology. There was some trouble between him and C. V. Riley later and he was forced to resign. He then got a position in the Patent Office, where he worked for many years, dying some years ago. (f) Alonzo H. Stewart. Although only a boy he was chief of the pages in the Senate. Probably he was 18 or 19 years old. He was greatly interested in insects and often brought in interesting specimens. He made a large collection of insects attracted by the light in the dome of the Capitol. (g) R. S. Lacey. Captain Lacey was a patent lawyer, who had a farm in Virginia and was interested strictly in economic entomology. (h) Edward S. Burgess. Professor Burgess was teacher of natural history in one of the high schools—I think the Central High School. He was a botanist by preference, but had an interest in insects. I believe he never read a paper before the Society. (i) R. W. Shufeldt. Doctor Shufeldt was an army surgeon and greatly interested in comparative osteology. He had collected some insects and helped the Society but never attended more than one or two meetings. (j) H. F. Riley. I regret that I have totally forgotten this man."

The following is a list of those who "We, the undersigned, hereby subscribe ourselves as members of the Entomological Society of Washington, under the Constitution entered on the preceding pages: Theo. Pergande, T. Eugene Oertel, Lawrence Bruner, E. A. Schwarz, J. G. Morris, L. O. Howard, Laurence

C. Johnson, John Murdock, W. S. Barnard, John B. Smith, C. V. Riley, Albert Koebele, P. R. Uhler, B. Pickman Mann, Alonzo H. Stewart, R. S. Lacey, Edward S. Burgess, R. W. Shufeldt, Geo. Marx, Charles Richards Dodge, Otto Heidemann, Otto Lugger, H. G. Hubbard, Th. L. Casey, H. F. Riley." He then showed on the screen in order the 15 photographs and told something about each man, somewhat as follows: 1. Theodore Pergande, a native of Silesia, of whom it was stated rather whimsically that he came to this country because the girls bothered him so much and because he disliked prayer meetings. On his arrival at New York he wandered into a railway station, and, as the man ahead of him at the ticket window bought a ticket to Syracuse, N. Y., he also bought a ticket to that place. On arrival there he found no one who spoke German and while wandering through the streets disconsolately saw a number of people entering a public building, and upon following them discovered that he was again in a German-Lutheran prayer meeting. A youth sitting beside him in a back seat invited him to his lodging place that night. The very next morning they encountered a recruiting station, and Pergande enlisted and served through the four years of the Civil War, making entomological collections over the various battlefields. Later he was employed in a gun factory in St. Louis and subsequently came to Washington with Riley. While an uneducated man, he made practically all of the notes of the Bureau for many years, and when Doctor Howard, just out of college, joined the staff and noting Pergande's difficulties with the English language, he recommended that he study the masterpieces of English literature to cultivate his style of writing. Very soon thereafter the notes were being written in the style of Edmund Spencer's "Fäerie Queene" and similar masterpieces in English literature! 2. Lawrence Bruner. The photograph shown was that of Bruner while on his wedding trip from Lincoln, Nebraska, to Washington. His bride was much impressed with Washington and stated that she "did not know before that houses could grow so close together." Some time later word was received from their home in Lincoln, Nebr., that a daughter had been born to them, and Doctor Howard wired if they named the child Psyche the whole Division of Entomology would stand godfather. After many months it was learned that the child actually had been named Psyche, whereupon the Division employees passed around the hat. She is now wife of the entomologist, Harry Smith. 3. E. A. Schwarz, remembered in terms of greatest affection by all who knew him. A learned, cultured man of kind sympathetic soul, modest and self-effacing, who did a great deal of good without ostentation, and who also had a rare wit. 4. The Rev. J. G. Morris, of Baltimore, author of some very excellent papers on Lepidoptera, notably "Catalogue of the Described Lepidoptera of North America," published in 1860 by the Smithsonian Institution. 5. Doctor Howard himself, in 1884, when the Society was founded. 6. John B. Smith, a Brooklyn boy, who studied law until entomology got the upper hold. He first studied beetles, and later Noctuid moths. He came to Washington in the early eighties, and was for a time Assistant Curator of Insects in the National Museum. He later took an entomological position in New Jersey and died there. He did admirable work in economic entomology, and especially on mosquitoes. 7. C. V. Riley, who was at that time about 44 years of age, of English birth, but, from his name, of

Irish descent, and whose career is so well known to all entomologists everywhere that it needed no discussion. 8. Albert Koebele as he looked when he first came to Washington. He later attained an international fame as an entomologist, particularly in connection with the introduction from Australia of parasites for control of scale insects in California, and for other valuable work performed on the Pacific Coast. 9. Philip Reese Uhler, of Baltimore, for a long time Librarian of the Peabody Library and author of many valuable works on Hemiptera-Heteroptera. During a visit to Baltimore in 1881, Uhler showed Doctor Howard with great pride a large manuscript comprising a monograph of the Capsidae. Upon inquiring why Doctor Uhler did not publish this work, he said "I am adding a few touches to make it perfect." He continued to do this for nearly 40 years until his death, and the manuscript was never published. 10. George Marx, famous spider specialist. Two slides shown, one at the time the Society was founded, the other is published with his obituary years later. A very fine man and an extremely witty one. Once when Herbert Osborn asked him if he had any children, he said "No, but I have some spiders." 11. Charles Richard Dodge, a graduate of Yale of the class of 1874 and assistant for a long time to Townend Glover, the first U. S. Entomologist. Dodge married an artist and she induced him to wear his necktie in the flowing way indicated in the portrait. He became very artistic indeed, and once showed a lot of pictures to a group of visitors, including Doctor Howard, calling attention to the excellencies, and asked for comment. One of the visitors told him the frame was the most beautiful he ever saw in his life, whereupon the disgusted artist said, "You are all a pack of darn fools." 12. Otto Heidemann, a token in his communistic days. In his early life he was a rabid communist, although the mildest, sweetest, most self-effacing fellow in his later days. He was originally a skilled wood-engraver, who became interested in entomology through doing work for the Bureau, and eventually became especially skilled in the Heteroptera. 13. Otto Lugger. A photograph showing him in the woods, collecting. He was an admirable entomologist; was Riley's assistant in Missouri during the early days. He had left Missouri and worked in Baltimore as Curator of the Maryland Academy of Sciences. He joined Riley's force again in Washington in the early 80's. He later became State Entomologist of Minnesota, where he died. 14. Henry G. Hubbard, for many years a very close personal friend of Doctor Schwarz—a friendship comparable to that of David and Jonathan, or of Damon and Pythias. A graduate from Harvard in the class of 1874; an entomologist of exceedingly high rank, and who finally died of tuberculosis. Two photographs: one on graduation from Harvard; the other about 1884. 15. Thomas Lincoln Casey, a graduate of West Point. Two pictures: one, just as he came to Washington in 1885; and the second taken shortly before his death. His very extensive collection of Coleoptera was willed, with his library, to the U. S National Museum. Following these 15 portraits, the speaker showed a striking portrait of Henry Ulke, who joined the Society in its second year. He was an artist, a portrait painter of unusual merit and skill, and a skilled pianist. An eager and assiduous collector of Coleoptera. He formed during his lifetime one of the largest collections of beetles in this country, which is now in the Carnegie Museum in Pittsburgh. Author of "Catalogue of the Coleoptera of the District of Columbia." An extremely interesting character. At the conclusion of his

remarks Doctor Howard produced a manuscript which he stated comprised a "bit of doggerel" recently discovered in the Society's archives and read at its 100th meeting, and which, after rereading by him, could be returned to the archives or turned over to the prohibition authorities. Apropos of certain passages in the "doggerel" he stated that Doctor Marlatt had always been unusually temperate, not consuming more than two or three mugs of beer, and that his name had been used "merely because it was necessary to have a name that rhymes with Pratt." The lines are as follows:

Ninety-nine meetings passed away,
Our hundredth meeting held to-day.
Think of discussions long and dry,
Of dissertations now gone by,
On transformations, malformations,
Bites and stings and on migrations,
Synonymous and species new,
Genera and families too,
Geographic distribution,
Insects almost Lilliputian,
Others of proportions great,
How they live and how they mate,
Wasps and ants and bees and bugs,
Caterpillars, beetles, slugs,
Lice and Lepidoptera,
Flies and Coleoptera,
Colors, marking punctuation,
Points of clothing and venation,
An endless mass of information,
Helping differentiation.

Think of this my friends and ponder;
Then think of something else and wonder.
This something else, I breathe it low,
Is how like fun the beer doth flow
After these dry talks on bugs,
Beer in bottles, beer in mugs,
Crackers, cheese and pretzels too,
Tobacco smoke till all is blue.
Argument and stories long,
Rarely some one starts a song.
Through it all however beer,
Six more there and ten more here.
Empty bottles stand in rows.
No one watches how time goes.
Gill and Riley hold the floor
Till Weismannism becomes a bore.
Then Marx a war-time story tells
So good that everybody yells.

False parasites are talked about
By Stiles until his breath gives out,
And Ashmead, Fernow, Schwarz and Jones
Become discursive, make no bones
Of fighting one another's views
On science, politics and news.
Meantime that quiet chap Marlatt
And Heidemann, Linell and Pratt
Say little, but not to seem queer,
Are downing mug on mug of beer.
And so we hardly realize
How very rapidly time flies
Till some spoil sport says "time to go,"
The others sadly say "just so,"
And all reluctant say good night.
'Tis worth remark that none are tight.

(*Secretary's abstract revised by author.*)

Due to lack of time, discussion of Doctor Howard's address was omitted.

The second communication on the program was given by Dr. N. E. McIndoo, of the Bureau of Entomology, and was entitled "Responses of blowflies to odors in a wooden olfactometer." In a preliminary report McIndoo briefly described his latest and most satisfactory olfactometer. It consists of a box, 12 inches square by 3 inches deep, which has a screen-wire top and a wooden bottom. In the bottom are inserted two cups, each of which is covered with a perforated disc. The cups connect with two bottles, one to hold the attractive or repellent liquid and the other to hold water as a control. These two bottles are connected with a larger one which in turn is connected with a blower pump. The pump forces air through the bottles and the air carries the odors and vapors through the discs to which the insects, when attracted, are counted at regular intervals. This apparatus is being used chiefly to determine the responses of *Lucilia sericata* and *Calliphora erythrocephala* to odors from fermenting and putrefying substances. Many interesting results, concerning the fundamental principles of attractants and repellents, are being obtained, but since this work is not yet sufficiently advanced a full report will be given later. (Author's abstract.) There was no discussion of this paper.

The next communication on the regular program was presented by Dr. J. W. Bulger and was entitled "Determination of toxicity of stomach poisons." Through the use of lantern slides Dr. Bulger gave a brief description of the apparatus used at the Takoma Park field laboratory for the determination of the relative toxicity of insecticides. Data obtained in 1929 by Dr. Campbell on the relative toxicity of cuprous cyanide, acid lead arsenate, sodium fluosilicate, barium fluosilicate, potassium fluosilicate, creolite, basic lead arsenate and aluminum arsenate were presented. It was pointed out that of these preparations only cuprous cyanide was more toxic to the silkworm than acid lead arsenate, and that acid lead arsenate was several times as toxic as basic lead arsenate. Mention was made of the possibilities of obtaining similar data for other insects than the silkworm. It was stated that preliminary information indicated that

at least three or more times as much acid lead arsenate was necessary to kill the tent caterpillar (*Malacosoma americana*) than was necessary to kill the silkworm (*Bombyx mori*). (Author's abstract). There was no discussion of this paper.

A vote of thanks was tendered by the Society to Dr. Campbell and staff for use of the meeting place and for the splendid hospitality shown.

Meeting adjourned at 9:40 P. M.

J. S. WADE,
Recording Secretary.

Actual date of publication November 23, 1931.

PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 33 DECEMBER, 1931 No. 9

DISTRICT OF COLUMBIA DIPTERA: RHAGIONIDAE.

By J. R. MALLOCH, C. T. GREENE, and W. L. MCATEE.

The Rhagionidae, long called Leptidae, have recently been revised by Leonard (see bibliography) and the present list follows in general the classification of that author. We exclude the genus *Xylomyia* Rondani, however, referring it to the Stratiomyiidae because of the fusion of the prosternum and pronotum. The prosternal plate in the Rhagionidae is clearly separated from the pronotum on each side by a membranous strip. The possession of a tubercle on the anterior or under surface of the hind coxa is a rather uniform feature of the family Rhagionidae though there is considerable variation in the degree of development, and in the position, of it. There is no tubercle at all in *Coenomyia* nor in the genus *Xylophagus* except in *X. nitidus* Adams, and it is very weak in *Dialysis*.

Systematic notes in this paper are by Malloch, and life history notes by Greene. The latter and McAtee wrote up the family in 1920 but decided to postpone publication until the appearance of Leonard's revision which was unexpectedly long delayed.

Insects of this family have sometimes been called snipe flies, a name no doubt suggested by that of the genotype of *Rhagio*, namely, *Musca scolopacea* L. which in turn seems to refer to the speckled coloration of the insect. Most members of the family have maculate wings and these are particularly noticeable in the genus *Rhagio* as the insects flush from their favorite head-down perches on the bark of trees to which they promptly return. The species of *Rachicerus*, *Dialysis*, and *Chrysopilus* usually are seen perched on foliage in sunny spots, those of *Xylophagus* may be found running over the fallen logs in which they passed their immature stages, while *Symphoromyia* draw attention to themselves by their efforts to bite, which as a rule, however, are not very determined. So far as known the larvae are predacious, and they live in the earth, under bark, in frass, or in decaying logs; a few are aquatic.

We present a table showing the number of species of the family collected in New Jersey (1910 List), New York (1928), and in the vicinity of the District of Columbia (excluding in each case synonyms and the genus *Xylomyia*).

Genus	*N. J.*	*N. Y.*	*D. C.*
Coenomyia	—	1	1
Rachicerus	—	—	3
Arthropeas	—	1	—
Glutops	—	1	—
Arthroceras	—	1	—
Xylophagus	3	3	4
Dialysis	2	1	2
Bolbomyia	—	1	1
Symphoromyia	1	2	2
Atherix	—	1	1
Rhagio	4	7	4
Chrysopilus	6	8	7
Total	16	27	25

Of the local species 19 have been taken on Plummers Island, Md., and all of the others in nearby sections of the Potomac River Valley, facts indicated in the list by the abbreviations, P. I., and V. P. I., when not conveyed by locality records cited in full.

Genus COENOMYIA Latreille.

C. ferruginea Fabricius.—Cabin John, Md., R. M. Fouts; near Jackson's Id., Md., May 30; Plummers Id., Md., June 1, 1902, H. S. Barber; Virginia opposite Plummers Id., May 23, 1914, R. C. Shannon; Glencarlyn, Va., May 30, N. Banks; Rock Creek, D. C., June 9, 1917, C. H. T. Townsend.

Genus RACHICERUS Haliday.

R. fulvicollis Haliday.—Glen Echo, Md., July 16, 1922, Malloch; Maryland, near Plummers Id., July 26, 1916, H. S. Barber; Falls Church, Va., July 13 to 23; Glencarlyn, Va., July 7 to 23, N. Banks; July 8, 1915, Greene; Glencarlyn to Barcroft, Va., July 18, 1915, McAtee.

R. nitidus Johnson.—Plummers Id., Md., July 11, 1915, R. C. Shannon; Great Falls, Va., June 25, N. Banks; June 25 to 29, 1915, June 28, 1917, Greene; Virginia opposite Plummers Id., June 27, 1915, R. C. Shannon. Larvae were collected from a rotten log at Rosslyn, Va., April 25, 1913, by R. C. Shannon, and from a decaying fallen trunk of sycamore at Great Falls, Va., April 12, 1924, by Greene; these pupated May 11 and adults emerged May 25.

R. obscuripennis Loew.—The most numerous of this rather uncommon group; has been taken in Piedmont localities from June 14 to July 18; P. I.

Genus XYLOPHAGUS Meigen.

This genus has been divided by Enderlein but Leonard did not include the divisions in his revision. The species with the first antennal segment twice as long as thick, and a transverse

impression of the frons, Enderlein retained in *Xylophagus*, and those with the first antennal segment three times as long as thick and no transverse impression on frons he removed to *Archimyia* Enderlein, with *atra* Meigen as genotype, ranking the segregates as genera. Herein these are treated as subgenera, a new subgenus is described for the reception of *nitidus* Adams, and a revised key to the species is presented. In view of the confusion that obviously has existed in the identification of species of this genus we list records here only of specimens available during preparation of the present paper.

KEY TO THE SPECIES.

1. Hind coxa with a short blunt process on inner side near middle; entire frons gray-dusted and evenly convex in profile at same level as eyes; mesonotum glossy black in front, paler behind, without gray dust, humeri pale yellow; antennae about as long as head, the basal segment not over twice as long as thick nor as long as width of frons at its anterior extremity, the frons in female over twice as long from anterior extremity to anterior ocellus as its width at anterior extremity (*Anaxylophagus* Malloch, new subgenus)........*nitidus* Adams

   Hind coxa without a process on inner side near middle; frons glossy on at least a portion of its surface except in *gracilis*........2.

2. Basal segment of antenna not three times as long as second and falling distinctly short of extending to anterior ocellus; scutellum with quite conspicuous pale erect hairs, most evident in the males (Subgenus *Xylophagus*)........3.

   Basal segment of antenna not less than three times as long as second and extending at least as far as anterior ocellus; scutellum with a few decumbent dark hairs, appearing bare except under a high magnification (Subgenus *Archimyia*)........7.

3. Frons entirely gray-dusted, less densely so in center near anterior extremity, and in male over twice as long as wide in front of anterior ocellus; metapleura dusted except in front; humeri yellow........*gracilis* Williston

   Frons gray-dusted above, polished black either in center or anteriorly; humeri not yellow........4.

4. Sternopleura and metapleura entirely glossy black, the latter microscopically alutaceous on a large part of their surfaces; abdomen in both sexes black; antennae inserted on a very slight elevation (best seen in profile)........5.

   Hind margin of sternopleura and all of metapleura lightly gray-dusted; abdomen of female with at least the second and third tergites largely orange-red, that of male rarely showing traces of red color on second and third tergites, antennae inserted on a well developed elevation when seen in profile........6.

5. Upper half of frons densely gray-dusted; posterior portion of meta-

pleurum with a group of closely placed microscopic hairs near upper margin below base of halteres.... *lugens* Loew

Frons in front of ocelli glossy black except for the usual narrow line of gray dust along each side; metapleura bare .... *lugens* Loew, var.

6. Back of head entirely glossy black, without a trace of gray dust.... *abdominalis* Loew, var.

Back of head entirely but lightly gray-dusted.... *abdominalis* Loew

7. Frons entirely glossy black from anterior ocellus to anterior margin; legs fulvous yellow, extreme bases of hind coxae on posterior side black, hind tibiae dark brown on entire dorsal surface, apical two segments of fore and mid pair dark brown, hind pair more extensively so, but basal segment generally entirely pale; metapleura without trace of hairs .... *decorus* Williston

Frons with a very distinct band of gray or brownish dust in front of anterior ocellus, glossy black in front of that portion except very narrowly on lateral margins.... 8.

8. Legs black, or brownish-black, the knees narrowly yellowish; posterior portion of metapleurum with a group of microscopic fine hairs; basal segment of antenna extending to beyond anterior ocellus .... *longicornis* Loew ♀

Legs much more extensively pale, sometimes almost entirely fulvous yellow.... 9.

9. Basal segment of antenna not extending beyond anterior margin of anterior ocellus; several stiff hairs on upper posterior portion of the metapleurum; hind tibiae entirely pale or very slightly browned at apices, and only the apical 2 segments of all tarsi dark brown .... *politus* Malloch, new species.

Basal segment of antenna extending well beyond anterior margin of anterior ocellus; no stiff hairs on upper posterior portion of the metapleurum; hind tibia distinctly infuscated on apical third or more, and the hind tarsi darkened from before apex of basal segment to tip.... 10.

10. Hind coxae distinctly black at bases and the abdomen but slightly shining and finely alutaceous on apical half or more of dorsum .... *longicornis* Loew ♂

Hind coxae not, or very slightly, darkened at bases and the abdomen glossy in both sexes.... *rufipes* Loew.

Subgenus ANAXYLOPHAGUS Malloch, new subgenus.

It is remarkable that in this subgenus there is a small rounded tubercle on the anterior side of the hind coxa similar to that found in all species of the genus *Xylomyia* Rondani, but which is lacking in both of the other subgenera dealt with below. Most genera of Rhagionidae have a more or less evident elevation on the same surface of the hind coxa but not as pronounced as in the group described.

Subgenotype *Xylophagus nitidus* Adams; this species is known only from the White Mountains, New Hampshire.

Subgenus XYLOPHAGUS Meigen.

X. abdominalis Loew.—Leonard has used the name *fasciatus* Walker for this species but that term is preoccupied by Say's identical name; both of these were originally combined with the genus named *Xylophagus;* Loew's name appears to be next in priority. We have seen only one local specimen, that from Great Falls, Va., April 20, 1913, R. C. Shannon.

X. lugens Loew.—Plummers Id., Md., April 12, 1915; Dead Run, Va., April 15, 18, 1916, April, 1923, R. C. Shannon.

Subgenus ARCHIMYIA Enderlein.

X. longicornis Loew.—Plummers Id., Md., May 8, 1915, May 7, 1916, May 4, 1919; Great Falls, Va., April 28, 1915; Dead Run, Va., May 8, 23, 1915, May 19, 1916, R. C. Shannon. Leonard states that the male is unknown, but a pair taken in copula (Plummers Id., May 7, 1916, of the preceding records) bears his determination label, the female correctly named, and the male incorrectly as *rufipes* Lw.

Xylophagus politus Malloch new species.—The characters used in the key will suffice for the recognition of this species, which is very similar to large examples of *rufipes* Loew, with the hind coxae very slightly darkened at bases and the hind tibiae entirely pale. Length, 15–18 mm.

Type and two paratypes Burke, Colo., May 12–14, 1904; and one paratype Kokanee Mt., B. C., August 10, 1903 (R. P. Currie). The first three specimens are in the collection of Owen Bryant, the last in that of the U. S. National Museum; it was labelled *decorus* Will, by Leonard.

X. rufipes Loew.—This species is called *reflectens* Walker by Leonard but it would appear better to use Loew's name in the absence of definite information as to the identity of Walker's type specimen which was not seen by Leonard. It may be noted as probable also that many of Leonard's records of males belong under *longicornis* and not in *rufipes*. Local records include: Plummers Id., Md., May 2, 1902, H. S. Barber; Great Falls, Va., April 28, 1915; Dead Run, Va., May 11, 1915; Rosslyn, Va., April 22, 1913, R. C. Shannon.

Genus DIALYSIS Walker

D. fasciventris Loew.—Plummers Id., June 19, 1913, R. C. Shannon; Dead Run, Va., June 23, N. Banks; June 30, 1916, R. C. Shannon. This species is readily distinguished by the presence of hairs on the central portion of the metanotum, a character it shares with the western *disparilis* Bergroth.

D. rufithorax Say.—Common and generally distributed; season of collection of adults, May 21 to July 12; P. I. Small examples have been named *D. elongata* Say, but we have not seen any specimens of that species from the District of Columbia region. It may be recognized by having but two veins emanating from the discal cell, the humeri much paler below and very noticeably white pollinose, the tergites each with a large fuscous triangular mark, and the fore tibiae entirely pale.

Genus BOLBOMYIA Loew.

B. nana Loew.—Originally described from the District of Columbia; Forest Glen, Md., April 28, 1914, Otto Heidemann; Virginia opposite Plummers Id., April 28, 1907, McAtee (this specimen the type of *Misgomyia obscura* Coquillett).

Genus SYMPHOROMYIA Frauenfeld.

S. cinerea Johnson.—This biting species has been taken in a number of localities, but paucity of information about it makes it worth while to cite all of them: Washington, D. C., May 5, 1895; Plummers Id., Md., June 2, 1916, McAtee; May 28, June 3, 1914, R. C. Shannon; Virginia near Plummers Id., June 2, 1916, McAtee; May 18 to 31, 1915, June 1 to 9, 1916, R. C. Shannon; Falls Church, Va., May 16, 1917, Greene.

S. hirta Johnson.—Glen Echo, Md., June 17, 1923, Malloch.

Genus ATHERIX Meigen.

A. variegata Walker.—Riverdale, Md., June, 1916, F. R. Cole; Plummers Id., Md., April, 1908, reared from pupa found in sand, E. A. Schwarz; June 3, 1914, R. C. Shannon; Glencarlyn, Va., May 9, N. Banks; Chain Bridge, Va., April 23, 1922, Malloch. Larvae were collected in Paint Branch, Md., near Beltsville, July 2, 1922, H. S. Barber.

Genus RHAGIO Fabricius.

R. mystaceus Macquart.—Common and generally distributed; dates of collection of adults range from April 20 to May 27; in copula May 9; P. I. Has been bred from pupae found in frass at base of oak tree, Falls Church, Va., April 19, 1919; also from larvae found in a rotten log of sycamore at Great Falls, Va., April 12, 1924, Greene.

R. plumbeus Say.—Beltsville, Md., June 14, 1914; Plummers Id., Md., May 30, 1909, McAtee.

R. punctipennis Say.—Common and widespread; season, May 11 to June 23; P. I.

R. vertebratus Say.—Common in the Piedmont; usual dates of

collection of adults extend from May 19 to June 23, but single specimens available are labeled July 7 and Aug. 31; P. I.

Genus CHRYSOPILUS Macquart.

C. basilaris Say.—Fairly numerous—mostly in Piedmont localities; season June 20 to July 24; V. P. I.

C. fasciatus Say.—Common in the Piedmont; dates of collection range from June 2 to July 23; P. I.

C. modestus Loew.—Numerous in the Piedmont; collection dates run from June 16 to July 25, but single specimens are available dated May 16 and August 22; P. I.

C. ornatus Say.—Common and generally distributed; ordinary season from May 30 to July 14, one specimen labelled May 6; P. I.

C. quadratus Say.—Locally this is the most common species of the genus; it is widespread but not so often seen in the Coastal Plain as is *C. ornatus*; its active season is longer than that of the others extending from May 23 to July 25, with single dates of collection also as late as Aug. 9, 28, and Sept. 8; comes to light; P. I. Has been reared from larvae taken in wet frass from a hole in a tree near Dead Run, Va., Greene.

C. rotundipennis Loew.—Fairly numerous; dates of collection range from June 20 to July 30; V. P. I.

C. thoracicus Fabricius.—Very common; known season May 21 to June 20; in copula, May 28, June 4; P. I.

BIBLIOGRAPHY.

ALDRICH, J. M.

The dipterous genus Symphoromyia in North America, Proc. U. S. Nat. Mus. 49, pp. 113–142, 1915.

S. cinerea doubtfully recorded from D. C. (p. 122).

BANKS, N.

Eastern species of Rachicerus, Proc. Ent. Soc. Wash., 15, No. 1, April, 1913, p. 51.

Records two species from Great Falls, Va.

COQUILLETT, D. W.

New Genera and species of Diptera, Proc. Ent. Soc. Wash., 9, pp. 144–148 (1907) 1908.

Misgomyia obscura new genus and species described from Plummers Island = *Bolbomyia nana*.

GREENE, CHARLES T.

Descriptions of larvae and pupae of two-winged flies belonging to the family Leptidae, Proc. U. S. Nat. Mus., 70, Art. 2, 20 pp., 3 pls., 1926.

Notes on seven species are based on local material.

LEONARD, M. D.
A revision of the dipterous family Rhagionidae (Leptidae), Mem. Am. Ent. Soc. 7, pp. 181+iv, 3 Pls., 1930.
Records 23 species (besides three of *Xylomyia* we refer to the Stratiomyiidae) from our region, only two short of the total of the present list.

LOEW, H.
Diptera americae septentrionalis indigena, Berlin Ent. Zeitschr, 1861, p. 58.
Bolbomyia nana described from Washington.

OSTEN SACKEN, C. R.
A list of the Leptidae, Mydaidae, and Dasypogonina of North America, Bul. Buffalo Soc. Nat. Sci., II (1874–75), p. 173, 1875.
Records *Leptis scapularis* Lw. (=*Rhagio vertebratus*) from the District of Columbia.

SHANNON, R. C.
Eastern Symphoromyia attacking man, Proc. Ent. Soc. Wash., 17, No. 4, Dec. 1915, pp. 188–189.
S. hirta various records = *S. cinerea*.

ADDITIONAL NOTES ON TYPES WITH DESCRIPTION OF A NEW GENUS (HYMENOPTERA : CYNIPIDAE).

By LEWIS H. WELD, *East Falls Church, Virginia.*

At the Zoological Museum in Lund, Sweden, are preserved the Dahlbom and C. G. Thomson collections of Cynipidae. TheThomson collection occupies two museum drawers and contains about 160 species of which about half are his own species. Nine are types of genera. There are two Dahlbom collections: his "museum" collection in two drawers; and his "private" collection in three small red drawers in a separate cabinet. Seven of his species are genotypes.

At the Zoological Museum in Berlin the Reinhard collection is distributed in the regular systematic collection as is also material from Mayr, Schlechtendal, Bassett, Kieffer and some of the Förster species. The von Halfern arrangement of Förster Cynipidae occupies 6 drawers in another cabinet and contains many genotype species. There are 6 additional drawers of unworked Förster material, about 17,000 specimens; most of the genotypes have been taken out but many manuscript names occur. Förster founded 64 genera of Cynipidae, 29 on his own species and of these all but one, *Dilyta subclavata*, have been found in the collection. In the regular collection is type material of most of the Hedicke genotype species. At the Deutsch. Ent. Inst. in Dahlem is a collection of about 100 species, 16 of which, including 3 genotypes, are not represented

in the other museum. Including both museums a total of 343 species, including 69 genotypes, will be found in Berlin.

In Vienna the regular collection occupies 119 drawers with 12 more of *inserenda*. It is richest in gall-making species (544) with 93 parasitic, making a total of 637 of which 66 are genotype species.

The Hartig collection of Cynipidae will be found intact in the Zoologische Staatssamlung in Munich. Thirty-four of his species are types of genera.

The Giraud collection is in Paris. Of his species 12 are types of genera. As he exchanged with Mayr, Giraud type material will be found in Vienna also. There are 2 Kieffer genotypes at Paris and 3 specimens of *Oberthürella lenticularis* Saussure which may be the types. The Cameron types are in the British Museum, whose collection totals 268 species of which 53 are genotypes.

Aspicerinae.

OMALASPIS Giraud.

Lambertonia Kieffer Bull. Ent. Soc. France 1901 : 158–9. Synonymy new.

Omalaspis norica Giraud, the genotype of *Omalaspis*, was described as having a closed radial cell. The two Giraud types in Paris have the radial cell open on the margin, a condition for which the genus *Lambertonia* seems to have been erected. The type of *Lambertonia abnormis* Kieffer, the genotype, has not been seen nor is its present location known to me, but there seems to be nothing in the published description that would prevent its being congeneric with *norica* and prevent *Lambertonia* from becoming a synonym of *Omalaspis*.

Figitinae.

ZYGOSIS Förster.

Diceraea Förster Verh. Zool.–Bot. Ges. Wien 19 : Abh. pp. 364, 367. Synonymy new.

In the Dahlbom "museum" collection in Lund were found 18 specimens of *Figites urticeti* Dahlb., the genotype of *Diceraea*, and one of these was selected as a lectotype. Förster established the genus *Diceraea* on the characters "eyes bare and first abscissa of subcosta obsolete," but the type specimens have the eyes hairy, the subcosta normally developed, the two sides of the areolet distinct and all pleurae and scutellum smooth so that they run to *Zygosis* in Förster's own key. The basal region of the subcosta which Dahlbom failed to see is slender but is

distinctly present and the membrane in front of it is very transparent.

Through the courtesy of Dr. N. A. Kemner one of the specimens from the Dahlbom "museum" collection was taken to Berlin and compared with a specimen of *Psilogaster heteropterus* Hartig on which Förster founded the genus *Zygosis* and the two were found to be not only congeneric but to be the same species. Later it was compared directly with the Hartig type of *heteropterus* at Munich and this conclusion was confirmed. I conclude that *Psilogaster heteropterus* Hartig, 1843, is a synonym of *Figites urticeti* Dahlbom, 1842 (Synonymy new), and that *Zygosis urticeti* (Dahlbom) is the valid name of the species. *Diceraea* becomes a synonym of *Zygosis* which has page precedence in Förster's key erecting these two new genera.

Anacharitinae.

CALOFIGITES Kieffer.

This monobasic genus was described in the Figitinae. The type of *Calofigites nitidus* Kieffer in Berlin lacks the head and the pin goes through the mesoscutum, but the habitus and particularly the heavy veins of the radial cell and the structure of the scutellum lead me to the conclusion that the genus belongs in the Anacharitinae.

ACANTHEUCOELA Ashmead.

Gonieucoela Kieffer, 1907, Ent. Ztschr. Stuttgart 21 : 112. Synonymy new.

After studying the type of the genotype species, *Gonieucoela bilobata* Kieffer, in Pomona College and *Gonieucoela brevidens* Kieffer in Berlin and paratypes of both now in the U. S. N. M. I conclude that the differences between this genus and *Acantheucoela* (in the sculpture of the posterior part of the disk of the scutellum) are too trivial to warrant maintaining *Gonieucoela* as a separate genus. The genus *Acantheucoela* was not familiar to Kieffer, who included it in Das Tierreich as an unnumbered genus. It was described from Cuba and has been found in Montserrat, Mexico, Brazil and Bolivia. The two species of *Gonieucoela* are from Belize, Nicaragua, Peru and Bolivia.

Eucoilinae.

EUCOILA Westwood.

Lytosema Kieffer, 1901, Feuille Natural. 31 : 159, 162. Synonymy new.

Ashmead and more recently Hedicke have published that the

genotype of *Eucoila* Westwood (not of authors) is a species with bare, non-ciliate wings and that *Psilodora* Förster is a synonym of it, its genotype being congeneric with *Eucoila crassinerva* Westwood.

An examination of the Dahlbom collection in Lund showed that *Eucoila guerinii* Dahlbom, the genotype of *Lytosema*, is also congeneric with *crassinerva* Westwood and therefore *Lytosema* should become a synonym of *Eucoila*.

Guerinii was species number 19 in Dahlbom's table published in 1842 in which the species was figured and the radial cell shown as open. No specimen bearing the name of *Eucoila guerinii* appears in the Dahlbom collection however. In 1846 he published a key to *Eucoila* in which the same number of species occurs and all are the same as in the former paper except that number 19 is here called *scutellaris* and specimens with this name do occur in both his "private" and in his "museum" collections and on one pin the name "Guerin" is written underneath *scutellaris*. He appears to have renamed the species for some reason in 1846 and this has been the Dalla Torre and Kieffer interpretation. These specimens of *scutellaris* agree with the figures of *guerinii* except that I should call the radial cell closed and should put it in *Psilodora* Förster, the only distinction Dalla Torre and Kieffer make between *Lytosema* and *Psilodora* being the open or closed cell. It seems therefore that *Lytosema* should go into synonymy and if species are ever found in this bare and non-ciliate winged group with a radial cell that is actually open a new name can be proposed for them if thought desirable.

BOTHROCHACIS Cameron.

Salpictes Kieffer, 1913, Voyage de Alluaud Hym. 1 : 31. Synonymy new.

The female holotype of the genotype species, *Salpictes rufiventris* Kieffer, is in Paris and when dirt was cleared away from the scutellum the disk was found to be coarsely punctate and truncated behind, the truncated end being slightly hollowed out. There seems to be nothing to separate this from *Bothrochacis* Cameron, a genus with which Kieffer was not familiar and which was described from males only.

KLEIDOTOMA Westwood.

Schizosema Kieffer, 1901, Feuille Natural, 31 : 158, 161. Synonymy new.

Kieffer founded this genus for two species, *Cothonaspis*

emarginatus Hartig which was described as having "abdomen basi denudatum" and *Pentacrita proxima* Ashmead, whose abdomen was said to be without a ring of hairs at the base. The Hartig holotype male of *emarginatus* at Munich *has* a hairy ring at base of second tergite and the characteristic wing venation, striate disk, and narrow cup of *Kleidotoma* although the obliquely truncate wing can hardly be called emarginate. As it is the genotype of *Schizosema* this genus becomes a synonym of *Kleidotoma*. The type of *proxima* Ashmead has not been examined; it is probably in the British Museum.

EUTRIAS Förster.

The types of the genotype species, *Eucoela tritoma* Thomson at Lund, 5 females and 2 males, have the disk of the scutellum distinctly longitudinally striate, tapering to a blunt triangular point behind the very narrow cup. The wing is very transparent, its surface dotted but bare in the female and with short pubescence in the male. In the male the margin of the fore wing is ciliate but only one of the five females shows any cilia on the margin. The wing is not truncate or emarginate but normally rounded at the end. It seems to me that Dalla Torre and Kieffer are in error in Das Tierreich, Lief. 24 : 111 (1910) in making *Eutrias* a subgenus of *Cothonaspis*. It is more closely related to *Rhynchacis* from which it is separated by the normally rounded wings or to *Eucoila* Westwood (not of authors) (= *Psilodora*) from which it is separated by the narrow cup and striate disk. It seems better to maintain it as a separate genus.

Cynipinae.

Diplolepis centricola (O S).

Cynips quercus-rubrae Karsch, 1880, Zeit. f. Naturw. 53 : 293, Pl. 6, fig. 4, a, b. Synonymy new.

I have compared the two types of *quercus-rubrae* in the Berlin Museum with determined specimens of *centricola* reared from *centricola* galls on post oak at Washington, D. C., the type locality, and find that they are the same. The Karsch galls agree with the *centricola* galls from *Quercus stellata* and I conclude that Karsch redescribed the species which Osten Sacken had described in 1863.

Amphibolips spongifica (O S).

Trissandricus maculipennis Kieffer, 1910, Boll. Laboro. Zool. Portici 4 : 115. Synonymy new.

The four types of *maculipennis*, on which Kieffer founded the genus *Trissandricus*, in the Berlin Museum, belong to the genus *Amphibolips*, an American genus with which Kieffer does not

seem to have been familiar. Through the courtesy of the Berlin Museum one of the paratypes was secured by exchange for the U. S. National Museum. It agrees in structure with *spongifica* and certain specimens in a series of *spongifica* reared at East Falls Church, Va., but a few miles from the type locality, agree with it in color; others have the thorax black like the head and are distinctly bicolored. I conclude that both the genus and species should disappear in synonymy.

Callirhytis corrugis (Bassett).

Callirhytis defecta Kieffer, 1910, Boll. Laboro. Zool. Portici 4 : 416. Synonymy new.

One of the two types of *defecta* in the Berlin Museum has both antennae 14-segmented; the other has 14 on one side and 13 on the other with a trace of subdivision on one side of the terminal segment. Through the courtesy of the Berlin Museum one of these was loaned in order that it might be compared directly with the holotype of *Cynips corrugis* Bassett in the Acad. Nat. Sci. in Philadelphia. The antennae of *corrugis* exhibit the condition found in one of the types of *defecta*, namely 14-segmented on one side and 13-segmented on the other. There seemed to be no difference in sculpture and I conclude that *defecta* is a synonym of *corrugis*.

I have taken what seems to be this species ovipositing in the buds of *Quercus velutina* at Washington, D. C., April 20, 1924, and at East Falls Church, Va., on April 18, 19, 20, 1927, April 19, 1928, and April 22, 1930. Some of these have 13-segmented antennae and others 14. Specimens have been compared directly with the type of *defecta* and with the type of *corrugis* and I should consider them all one species. They oviposit on the side of the elongating buds about midway of their length when the buds are from one-half to three-quarters of an inch long, selecting usually the topmost buds on vigorous shoots from stumps. The gall from which they have emerged has not yet been discovered nor has the alternating gall which they produce.

Through the courtesy of the Berlin Museum I am able to describe the following new genus in the Eucoilinae recognized among undetermined material.

PERISCHUS n. g.

This genus and *Zamischus* Ashmead are separated from all the rest of the known Eucoilinae by having a remarkably long and slender body, both the neck of the propodeum and the petiole of the abdomen being unusually elongated. Both have the head massive, broader than the thorax, the antennae arising far above the middle of the eyes, the lateral bars at base of scutellum broad and striate, the mesopleurae aciculate, the wings pubescent and ciliate, and the

second tergite bare at the base. Both are neotropical. *Perischus* (name from *peri* and *Zamischus*) differs in having filiform antennae, the neck of the propodeum not reaching as far back as the distal end of hind coxae, a closed radial cell and a transversely sculptured mesoscutum.

Genotype.—*Perischus boliviensis* which is described below. Monobasic.

Perischus boliviensis n. sp. (Fig. 1).

Female.—Black; mandibles, tibiae and tarsi reddish-brown. Head smooth and polished with a few setigerous punctures on face; from above the axial line .65 transfacial, cheeks not broadened behind the eyes, not margined; from in front broader than high, interocular space .47 transfacial and area .9 as broad as high, malar space .4 eye with a fine malar groove, clypeal area higher than broad. Antennae arising high on face, filiform, as long as body, 13-segmented, lengths as (scape) 12 (width 4.5) : 6 : 21 (3) : 23 : 24 : 25 : 24 : 22 : 20 : 18 : 18 : 18 : 20 (4), the third seen from above slightly bent inward, all flagellar segments cylindrical and closely joined. Sides of prothorax produced backward, mostly smooth but striate below, the truncation .4 width of head and not quite half the width of thorax, with deep lateral indentations, shallowly emarginate above.

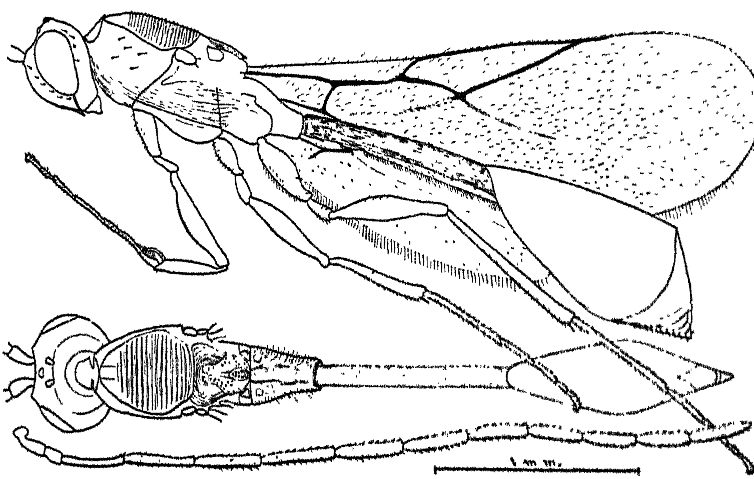


Fig 1. *Perischus boliviensis* n. sp. Lateral view, dorsal view and antenna.

Mesoscutum somewhat triangular, longer than broad, shining, with about 20 fine sharp transverse ridges, smoother anteriorly where are fine anterior parallel lines, without trace of parapsidal grooves. Scutellum .6 as long as mesoscutum with two small smooth pits at base and broad striate lateral bars, the disk punctate, rounded behind, faintly margined, the cup but slightly elevated, tapering in front into a long polished septum between the pits, its surface flat

with coarse confluent punctures, over three times as long as broad, not quite reaching end of disk. Mesopleurae much elongated and separating the middle coxae far from anterior, longitudinally striate, smoother below, the mesosternum with a fine median carina. Metapleurae also striate. Propodeum longer than scutellum, not as long as width of head, its neck with two prominent carinae dorsally, the sides rugose and pubescent. Wings clear but the pubescence and cilia dark like the veins, radial cell closed, 4.8 times as long as broad, the marginal vein prolonged beyond apex of radial cell, cubitus partly formed, areolet absent. Legs long and slender; segments of front leg as (coxa) 18 : 9 : 38 : 26 : 61 (= 26 + 13 + 9 + 5 + 8); of hind leg as (coxa) 29 (9) : 9 : 43 : 61 : 84 (=42 + 17 + 12 + 5 + 8); claws fine, simple. Petiole cylindrical, slightly carinate on sides, dull, longitudinally striate, 11.5 times as long as broad, shorter than rest of abdomen, which is somewhat compressed laterally, second tergite largest, bare at base, without punctures; lengths of tergites along dorsal curvature as (petiole) 69 (6) : 73 : 26 : 2 : 9. Using the width of the head as a base the length of mesonotum ratio is 1.4, wing 5.1, antenna 6.1. Length 3.5 mm. Antenna 3.55 mm. Wing 2.95 mm.

Described from two specimens from Coroico, Bolivia. Type and paratype in the Zoological Museum in Berlin. Wing, antenna and legs from one side of the type in balsam on slide in U. S. N. M.

A NEW SPECIES OF TERMITE, RETICULITERMES ARENINCOLA, FROM THE SAND DUNES OF INDIANA AND MICHIGAN, ALONG THE SHORES OF LAKE MICHIGAN.

By EUGENE J. GOELLNER, *Department of Zoology, University of Chicago.*

The eastern species of termite, *Reticulitermes flavipes* Kollar, had been always considered to occur in the Indiana dunes along the southern shore of Lake Michigan. In 1929 Park[1] reported the western species, *Reticulitermes tibialis* Banks, from this region. A study of the distribution of these two species of termites was undertaken in the fall of 1930. At the very outset of the investigation, the species considered in the past as *Reticulitermes flavipes* Kollar exhibited such morphological differences from the eastern species as to warrant describing it as a new species.

According to present knowledge, *Reticulitermes arenicola* sp. n. appears to be typically an inhabitant of sandy places. It occurs side by side with *Reticulitermes tibialis* Banks in the Indiana sand dunes.

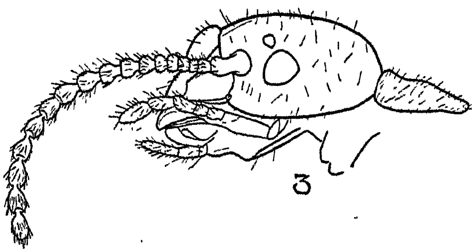
A few records of it were obtained from the dunes of Western Michigan, from the Indiana border to New Buffalo, at Stevens-

[1]The author is indebted to Dr. Alfred E. Emerson of the University of Chicago, under whom the work was done, and to Dr. T. E. Snyder of the U. S. Department of Agriculture.

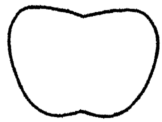
ville and Grand Haven. Collecting was carried on in Michigan chiefly to establish the presence of *Reticulitermes tibialis* Banks in that State.

Reticulitermes flavipes Kollar was taken in the dunes only at Saugatuck and Grand Haven, Michigan; but not in the Indiana dunes. It occurred, however, in other localities in Indiana where mesophytism prevailed.

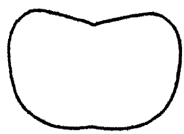
The colonizing flights of *Reticulitermes arenincola* sp. n. occur toward the end of May.



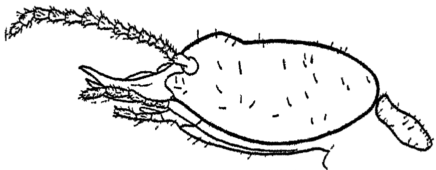
3



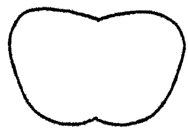
5a'



5b



4



5c

Fig. 3. Side view of head of sexual alate adult of *R. arenincola*.

Fig. 4. Side view of head of soldier of same species.

Fig. 5a. *R. arenincola*, dorsal view of pronotum of first form reproductive individual. b. *R. flavipes* Kollar, variant from Arkansas, dorsal view pronotum, first form reproductive individual. c, Pronotum typical *R. flavipes*, first form reproductive individual.

Morphology of **Reticulitermes arenincola**, sp. n.

Diagnoses.

Winged imago.—Smaller than *R. flavipes*, ocelli less than their diameter from the eye (in *R. flavipes* ocelli are more than their diameter from the eye); smaller than the variant from Arkansas (2); differs in color and total length from *R. hageni* Banks; these being brown to blackish brown and from 9 to 10 mm. in length for *R. arenincola* sp. n., and pale brownish yellow and 8 mm. in length for *R. hageni* : differs from *R. virginicus* Banks also, in total length and with respect to the distance of ocellus from the eye (length of *R. virginicus* hardly 8 mm.,

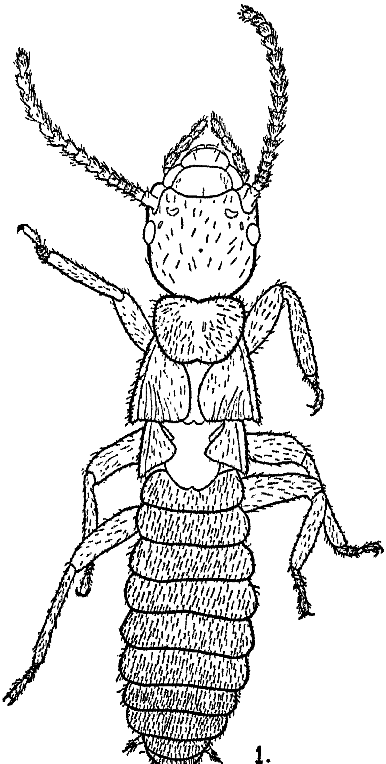
ocellus closer to the eye than in *R. arenincola* sp. n : the shiny black color and dark tibia of *R. tibialis* separate this termite from the new species : the pronotum of *R. claripennis* Banks is relatively wider than that of *R. arenincola* sp. n.; the pronotum of the new species is also relatively narrower than that of the other species. Compare pronotum of *R. flavipes* (Fig. 5c), of variant of *R. flavipes* from Arkansas (Fig. 5b), of *R. arenincola* sp. n. (Fig. 5a).

Soldier.—Smaller than *R. flavipes*, sides of head about parallel (Fig. 2); minimum width of gula much narrower than maximum width; for field characters of the *R. tibialis*, *R. flavipes*, *R. arenincola* sp. n., soldier see Table 1 : resembles the soldiers of *R. virginicus* and *R. hageni* in size.

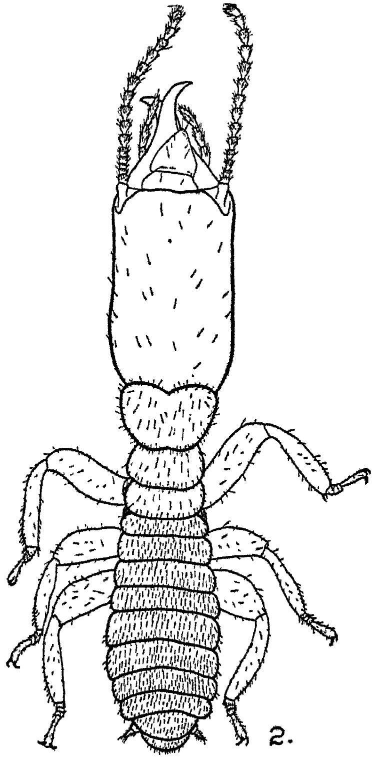
Worker.—Smaller than *R. flavipes*, whitish, length from 4.12 to 5.02 mm. abdomen and head narrower than in *R. flavipes*, head width from .947 to 1.00 mm.; length of head and mandibles 1.28 mm.

Description of **Reticulitermes arenincola**, sp. n., winged imago.

Imago.—Vertex and front brownish black, occiput lighter, pronotum a trifle lighter than head; anterior half of clypeus whitish, posterior half yellowish



1.



2.

Fig. 1. Dorsal view, dealated adult of *Reticulitermes arenincola* n. sp. Doellner.
Fig. 2. Dorsal view, soldier of same species.

brown; anterior halves of mesa- and metanotum lighter brown than posterior halves, with a blackish irregular line across the medial constrictions : first five abdominal terga about the color of pronotum, the other darker, shades of color, however, variable; femora almost an olive brown; tibia and tarsi a pale yellowish white; color of wings variable, white to dusky.

Head (Fig. 1) not strongly hairy; sterna strongly hairy with a row of a few large hairs at the posterior margin; pleural membrane of female covered with a thick coat of brownish hair.

Length of hair from posterior margin to clypeal suture a little shorter than width behind eyes; sides about parallel rounding with a broadly convex posterior margin beginning a little behind the eyes.

Sutures of head, except the longitudinal suture, not visible; fontenelle present, not prominent, at about the level of the posterior margin of the eyes.

Labium very pale; labial palpi and first four maxillary palpi slightly browned.

Gula about the color of the pronotum; anterior tip white, about .066 mm. in length; gula longer than wide, slightly narrowing distally at end of pigmented area; surface of gula slightly bulging posteriorly, flat anteriorly.

Clypeus, posterior margin wider than anterior and slightly convex; length measured along the medial line about one half as long as greatest width; suture invisible in the middle of the brownish, posterior part of labrum; posterior pigmented area swollen and higher than anterior limits of frons; pigmented area about .103 mm. in length.

Labrum a little wider than long; greatest width about .08 mm. from proximal end.

Antennae spots visible, less than half their width from the ocelli and slightly crescentic in shape; long axis parallel with width of head; posterior margin rounded.

Ocelli hyaline, less than their diameter from the eye; antero-ventral side flattened, postero-dorsal side rounded.

Eyes triangular in shape with rounded angles; altitude about .199 mm.; sides of triangle tend to be equal in length.

Pronotum slightly narrower than head; anterior margin raised and slightly biconvex; median notch distinct; antero-lateral angles rounded, viewed dorsally; antero-lateral border reflexed; lateral margin not receding strongly toward biconvex posterior margin. T-shaped area clearly visible.

Antennae, 17 segments; first segment longest, over twice as long as broad, widest near distal end; third segment smallest.

MEASUREMENTS OF AN IMAGO, *Reticulitermes arenincola*, sp. n.

Length without wings	4.16 – 5.30 mm.
Length with wings	9.00 –10.00
Width of abdomen	.91 – 1.10
Head, length to clypeus	.770
" width behind eyes	.81 – .90
" length to tip of labrum	1.09 – 1.24
Gula, length	.359
" length of white anterior margin	.066
" width, maximum	.311

Gula, width, minimum anterior	.244
Labrum, length	.311
" width	.355
Clypeus, posterior width	.444
" anterior width	.311
" length measured along medial line	.213
Crescentic antennae spot, width	.06 - .08
" " " distance between tip of the two horns	.133- .155
Ocelli, length	.080
" width	.059
Eyes, altitude of triangle	.199
Pronotum, ant. max. width	.71 - .77
" length	.51 - .56
Antennae, length	2.443
1st segment, length	.222
" " greatest ant. width	.055
3d segment, length	.044
Cerci, length	.044
" " apical segment	.079
Forewing, length to suture	6.720
Hindwing, length to suture	6.400
Forewing, width	1.737

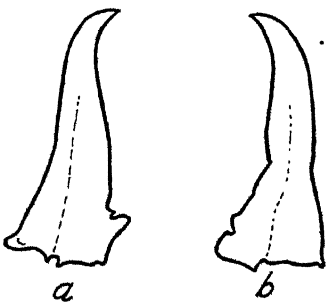


FIG. 6.

Fig. 6 a. *R. arenincola*, soldier, left mandible. b. Right mandible of same.

Description of **Reticulitermes arenincola**, sp. n., Soldier.

Head pale yellow, paler beneath, mandibles dark brown, antennae yellowish, pronotum and remainder of body with small brownish yellow hairs.

Hairs of head scattered; head not strongly pilose; abdomen strongly pilose, with a single row of a few large hairs, some erect, near margin of sterna; hairs of tibia directed posteriorly, on distal half more spine-like, three such spines on apical ends of prothoracic tibia, two such spines on the other.

Head elongate, without mandibles less than twice as long as broad, posterior margin broadly rounded, sides parallel, anterior and posterior widths not noticeably different; fontanelle not prominent but distinct; head viewed from side

shows frons bulging and sloping toward clypeus; ventral surface slightly convex, gently curving upward to mandibulate articulation; on the whole tends to be parallel with the dorsal surface posterior to fontennelle; frons biconvex with a shallow median depression.

Clypeus overlapping labrum a little (this condition not frequent); broader than long; anterior margin straight; sides posteriorly almost parallel to middle of clypeus, then strongly receding; in others lateral margins slope gently inwardly to the anterior margin.

Labrum narrowing distally to a slightly rounded hyaline tip with two long hairs pointing forward; length of labrum measured from end of clypeus about the size of greatest width near base of labrum.

Eyes and ocelli suggested by round hyaline spots where such organs are located in the first form reproductive individuals.

Antennae: 14 to 16 segments; segments 2, 3, 4, not constant; first segment longest, cylindrical, little less than twice as long as broad, broader anteriorly and posteriorly; second segment a little longer than wide; third segment sometimes smaller than the rest; the remainder increasingly larger to about the eighth segment; segments 2, 3, 4, occasionally approximate one another in size so as to form a rather distinct antennae section; the last segment somewhat ovate and narrower than the preceding.

Gula narrows posteriorly, maximum width more than twice the minimum width.

Mandibles shorter than the length of head, right a little longer than the left; external and internal border of right mandible rather straight, a slight concavity posterior to the distal half of the external edge; tip pointed and curved about at right angles to the long axis; left mandible, external margin beginning at a distance one-fourth the mandibular length from proximal end, straight; tip as in right mandible; inner edge not straight but sloping to tip with a slightly ventral flexure of blade near the distal end.

Pronotum, anterior margin biconvex, in some weakly so, notch sometimes pronounced; antero-lateral corners not broadly rounded, lateral margins do not recede rapidly toward the slightly biconvex posterior margin from the antero-lateral corners; notch in the middle of posterior margin either slight or pronounced, usually the former.

Cerci, base broad, second segments longer and pointed; styles shape of apical segments of cerci, thinner and a little shorter.

Measurements of a soldier, *Reticulitermes arenincola*, sp. n.

Length, total	4.660–4.940 mm.
Head and mandibles, length	2.280–2.560
Head to clypeal suture, length	1.559
Head width, maximum posterior	.94 –1.09
Fontanelle, distance from clypeal suture	.422
Labrum, length	.333
Clypeus, posterior width	.399
" anterior width	.177
Antenna, length (16 segments)	1.463
First segment, length	.155

First segment, maximum anterior width	.097
Second segment, length	.088
" " width	.060
Pronotum, width (not removed and flattened)	.731- .870
" length	.459- .574
Gula, length	1.119
" max. width	.402- .460
" min. width	.152- .180
Mandibles, left, length	.888
" right, length	.933
" right, max. width	.162
Cerci, length	.133

Type locality.—Pine, Indiana, several miles west of Gary, Indiana.

Range.—From Buffington eastward along the dunes to Michigan City, Indiana; thence northward along the dunes of Western Michigan to Grand Haven.

Described from several winged imagos and soldiers from a large colony collected at Pine, Indiana. The range in some measurements has been computed from specimens collected in the Indiana and Michigan dunes. Material preserved in 80% alcohol.

Type material deposited with the A. E. Emerson Collection at the University of Chicago.

Field Characteristics of Reticulitermes Species, *R. tibialis* Banks, *R. arenincola* sp. n., *R. flavipes* Kollar, Using Soldier Caste.

The identification of *R. tibialis* Banks, *R. flavipes* Kollar, and *R. arenincola* sp. n. by means of the soldier caste greatly facilitated the work in as much as it was possible to identify each colony in the field at sight without having recourse to Light's (3) new method of differentiating species by the soldier caste in terms of indices or mathematical expressions of relative proportions between parts or sizes of parts. Recourse to this new method, one that presents a laboratory problem, would be necessary were the identification of *R. arenincola* sp. n. and such species as *R. virginicus* Banks and *R. hageni* Banks in question. Reliable field characters of each species (soldier caste) occurring in the Chicago vicinity[1] are to be found in the table below. They permit identification of the colony in the absence of winged first reproductive forms. The color of head and the relatively wide minimum width of the gula of *R. tibialis* had been mentioned by Banks and Snyder (4).

[1]Chicago vicinity: The dune regions in Indiana and Michigan.

TABLE I.

	R. tibialis	*R. flavipes*	*R. arenincola*
1. Color of head	Dull brownish	Pale yellow	Pale yellow
2. Minimum width of gula	Wider than that of the other two species—from .228 to .289 mm.	Narrower than preceding—from .18 to .28 mm.	Narrower than that of tibialis from .15 to .18 mm., approaching in some cases .228 mm.
3. Head and mandibles (length)	Variable, but of no diagnostic value	Large, from 2.65 to 3.20 mm.	Small, from 2.285 to 2.56 mm.

BIBLIOGRAPHY.

1. PARK, O., 1929.
Reticulitermes tibialis Banks in the Chiacago area. Proc of the Entomological Society of Washington. Vol. 31, No. 7, pp. 121-126.
2. SNYDER, T. E., 1926.
Races or sub-species in Reticulitermes. Proc. of the Biological Society of Washington. Vol. 39, No. 1., pp. 1-6.
3. LIGHT, S. F., 1927.
A new and more exact method of expressing important specific characters of termites. Univ. of Calif. Publications in Entomology. Vol. 4, No. 5, pp. 75-88.
4. BANKS, N. AND T. E. SNYDER, 1920.
A Review of the Nearctic Termites. U. S. Nat. Mus. Bull. 108.

MINUTES OF THE 431st REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON.

The 431st regular meeting of the Entomological Society of Washington wa held at 8 P. M. Thursday, October 1, in Room 43 of the new building of the National Museum. In the absence of Dr. A. C. Baker, President, Mr. F. C. Bishopp, first Vice-President, presided. There were present 49 members and 41 visitors. The minutes of the previous meeting were read and approved. The following individuals were admitted to membership by vote of the Society: Argyle B. Proper, Gypsy Moth Laboratory, 1156 Main St., Melrose Highlands, Mass.; Stansbury Hayden, care of Maryland Academy of Sciences, Baltimore, Md.; R. W. Wagner, University of Maryland, College Park, Md.; Dr. Alan Stone, Foster H. Benjamin, Miss Kathleen McClure, Miss Irene L. Bartlett, Miss Catherine Ford, Dr. H. H. Richardson, S. W. Simmons, U. C. Lofton and Dr. Wm. Robinson, U. S. Bureau of Entomology. The Recording-Secretary, Mr. Rohwer, requested more prompt payment of dues on part of all

delinquent members as the funds were low for payment of current printing bills.

The first topic on the regular program was entitled "The Maggot Treatment of Osteomyelitis" and papers were given by F. C. Bishopp, G. F. White, and Wm. Robinson. Mr. Bishopp in his discussion pointed out that the use of larvae of blow flies, particularly *Lucilia sericata* and *Phormia regina*, in the treatment of the grave bone disease known as osteomyelitis as a regular hospital procedure is new and revolutionary. This method was introduced recently by the late Dr. Wm. S. Baer of Johns Hopkins University, Baltimore, Md. The results have been very encouraging and the method is now being followed in more than a score of hospitals. Dr. Baer's work was based on his observations of the apparent beneficial effects of larvae which gained entrance to wounds on the battle fields during the world war. Similar observations were made by military surgeons as far back as the Napoleonic wars, but it remained for Dr. Baer to make application of the idea. In the early stages of the work in 1929 the Bureau of Entomology lent such aid as it could with reference to methods of rearing and handling blow flies and during the summer of 1930 Dr. D. F. Miller was employed, and Dr. G. F. White was assigned to the problem of developing rearing technique suitable for hospitals, and methods of producing sterile larvae. In 1931 Dr. Wm. Robinson was appointed and assigned to the investigation. It is the desire of the Bureau to clear up some of the many entomological questions involved, especially as to the relative effectiveness of different species of blow flies, how the beneficial results are produced by the larvae, and to perfect a method by which an abundant supply of sterile larvae can be made available at all times.

Dr. G. F. White in course of his remarks pointed out that the chief danger attending the use of maggots in surgical wounds lies in the possibility that disease-producing germs might be introduced into the wounds with the maggots. The surgeon therefore must be furnished with maggots free from harmful micro-organisms. The method of obtaining these consists in rearing larvae from sterilized eggs and testing the sterility of the larvae before they are used. Added precaution to insure sterility is taken in the rearing, in the food, and in the care of the adult flies. To make sure of an ample supply of surgical maggots for any hour of the day throughout the year refrigeration is provided for prepupae and pupae and a favorable temperature and humidity for the adult flies. Larvae that are ready for the surgeon are subjected to lowered temperatures to limit their growth until they are needed.

Dr. Robinson, discussing other phases of the problem, pointed out that the maggots shorten the time of recovery from osteomyelitis and also bring about cures in many cases which otherwise have not yielded to the best surgical treatment. Among the essentials for recovery are the complete removal of dead and dying tissue and the disinfection of the wound. These have been difficult to accomplish by ordinary surgical means; and a brief description was given of some of the difficulties encountered by surgeons in treatment. The maggots in their feeding eat and remove effectively the dead tissue and they can penetrate into otherwise inaccessible places in the wound. Also in some way they cause a decrease in the number of the infecting bacteria. The methods of applying the maggots to the wounds and of removing them were mentioned.

During the first few days of the maggot treatment, some of the patients complain that the maggots cause sharp, intermittent pains; but this decreases shortly and the patients usually become quite tolerant of the maggots in the wound. (Author's abstracts.)

The subject was illustrated by a reel of moving pictures. Comments were made by Aldrich, Ewing, Rohwer, McIndoo, and Gahan.

The second paper on the regular program was entitled "Entomological Work at the University of Maryland," by Dr. E. N. Cory. The speaker stated that down to 1919 the work of entomology was combined with that of zoology and known as the Department of Entomology and Zoology. At that time, in order to conform with the requirements of rating agencies, the Department was split and the zoological work was placed in a newly formed School of Arts and Sciences. Even before that time subject matter was the basis of all efforts and there was one head responsible for the educational, research, extension and regulatory activities. Budgets for these, of course, were in the main derived from several sources. The University of Maryland has a unique position among colleges teaching entomology, in that it lies within a few minutes' run of the U. S. Department of Agriculture, the Bureau of Entomology, the Smithsonian Institution, and the U. S. Public Health Service. No other school has such superior advantages. The registration in entomological courses has steadily increased and from 1925 the increase has been remarkable. At the close of last year the registration for 1930–1931 totaled 220. This included about 15 graduate students. The speaker also discussed briefly the matter of space, equipment and funds, including library facilities, the cooperative work with the Enoch Pratt Library of Baltimore and a natural history club. He also described briefly the work with the Conservation Commission of Maryland in the establishment of a laboratory at Solomons Island. In addition to discussion of resident work there was given a resume of extension activities, cooperation with county agents, State beekeepers' organization, and extension teaching work; through exhibits, county and state meetings, various commodity organizations, radio talks, and the like. A list of the projects under investigation were given to indicate scope of activities. Work on individual farms and at the field laboratory at Hancock was stressed. A brief program also was devoted to regulatory work with special emphasis on education of the public as to rights, privileges and responsibilities. Finally it was stressed that the idea that animates the entire Department of Entomology is one of service to the State and Nation, particularly to taxpayers and young people. (Secretary's abstract reviewed by speaker.)

Remarks were made on invitation by C. R. Kellogg, a visitor from China, who reviewed very briefly the entomological work in that country from ancient times down to present status. Another visitor, Mr. H. A. Jaynes, of Trujillo, Peru, also on invitation briefly addressed the Society concerning recent work in South America.

Meeting adjourned at 10.15 P. M.

J. S. WADE,
Recording Secretary.

Actual date of publication December 28, 1931.

INDEX TO VOLUME 33